# SCIENCE

NEW SERIES
VOL. LXX, No. 1804

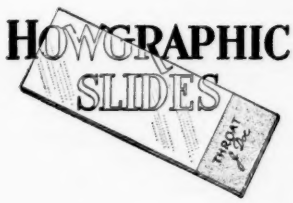
FRIDAY, JULY 26, 1929

ANNUAL SUBSCRIPTION, $6.00
SINGLE COPIES, 15 CTS.



## "HOWGRAPHIC"
## *Microscope Slides*

***No Labels to Come Off and Cause Confusion***
***No Special Pencil Necessary***




have a special writing surface where notations may be made with pencil or pen. Indelible ink is used when permanent record is desired.

Experimentation has given a glass which, from the standpoint of light transmission, freedom from corrosion, and freedom from other imperfections, is unsurpassed.

The regular "Howgraphic" Slides when viewed from the edge have a slightly greenish cast, but this does not interfere with their optical properties when used with the microscope.

The "Howgraphic" Slides are cut by a special process which eliminates the roughness ordinarily experienced from cut edges and makes ground edges unnecessary for all practical purposes. They are also carefully selected for thickness. This greatly increases the satisfaction in using them and adds to the accuracy of the results obtained with them. The name "Howgraphic" insures a quality microscope slide with a place to write on, at an atractive price.

*Write for Bulletin No. 420.*

# EIMER & AMEND

**Established 1851, Incorporated 1897**

***Headquarters for LABORATORY APPARATUS and CHEMICAL REAGENTS***

**We have no agents. To be sure of E.&A. material order direct.**

**NEW YORK, N. Y.**
**Third Ave., 18th to 19th St.**



*Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.*

*Just out, from the*

**Museum of Vertebrate Zoology**
**University of California**

GRINNELL AND LINSDALE — **A New Kangaroo Rat from the Upper Sacramento Valley California**
*Illustrated, 25 cents*

STORER, TRACY R. — **Notes on the Genus Ensatina in California, with a Description of a New Species from the Sierra Nevada**
*25 cents*

BURT, WILLIAM HENRY — **Pterylography of Certain North American Woodpeckers**
*Illustrated, 25 cents*

**University of California Press**
**Berkeley, California**

**COLOUR**
**AND COLOUR THEORIES**
***By Christine Ladd-Franklin, Ph.D.***
*Lecturer in Columbia University*

"What appears to me the most natural and the most competent theory of color vision that has ever been presented to the scientific world. Dr. Ladd-Franklin has marshalled the evidence in the clearest of English. The volume should find a place in every library of physics."—PROF. HENRY CREW, *former President of the Physical Society.*

"An alternate theory of vision which solves many of the difficulties presented by the classical theories."—PROF. H. C. WARREN, *Science.*

"A volume which, by its vigor, constitutes a contribution to the literature of color really unique."—DR. DEANE B. JUDD, *Bureau of Standards.* $3.50

**HARCOURT, BRACE AND COMPANY**
**383 *Madison Avenue, New York***

**The Journal of General Physiology**
EDITED BY
W. J. CROZIER — JOHN H. NORTHROP — W. J. V. OSTERHOUT
**Contents of Volume XII, No. 6, July 20, 1929:**

ABRAMSON, HAROLD A. The cataphoretic velocity of mammalian red blood cells.
HECHT, SELIG, and WOLF, ERNST. The visual acuity of the honey bee.
OSTERHOUT, W. J. V., and HARRIS, E. S. The concentration effect in *Nitella.*
SIMMS, HENRY S. Chemical antagonism of ions. IV. Effect of salt mixtures on glycine activity.
COOK, S. F. The effect of sudden changes of temperature on protoplasmic streaming.
MACINNES, D. A., and DOLE, MALCOLM. A glass electrode apparatus for measuring the pH values of very small volumes of solution.
HILL, SAMUEL E. The validity of the glass electrode in ammonium chloride buffers.
EAGLE, HARRY. A method for the titration of complement.
EAGLE, HARRY. The mechanism of complement fixation.
EAGLE, HARRY, and BREWER, GEORGE. Mechanism of hemolysis by complement. I. Complement fixation as an essential preliminary to hemolysis.
HILL, SAMUEL E. The penetration of luminous bacteria by the ammonium salts of the lower fatty acids. Part I. General outline of the problem, and the effects of strong acids and alkalies.

*THE JOURNAL OF GENERAL PHYSIOLOGY, founded in 1918 by Dr. Jacques Loeb, contains practically all the investigations of Dr. Loeb after that time.*
*There are, in addition, contributions by many leading physiologists, both in this country and abroad.*
*It has now been decided to offer a complete set of the back volumes at half price to new subscribers. The first twelve volumes complete may therefore be obtained for $30.00 by new subscribers, until December 31, 1929.*

**SUBSCRIPTION PRICE PER YEAR (ONE VOLUME), $5.00.**
PUBLISHED BIMONTHLY BY
**The Rockefeller Institute for Medical Research**
**YORK AVENUE AND 66TH STREET — NEW YORK, N. Y.**

# SCIENCE

VOL. LXX FRIDAY, JULY 26, 1929 NO. 1804

*Some Problems of Cosmical Physics:* LORD RAYLEIGH 77

*The Decline in the Average Length of Life:* PROFESSOR C. H. FORSYTH 85

*Obituary:*
*Sidney Savory Buckman:* DR. C. H. CRICKMAY. *Recent Deaths* 87

*Scientific Events:*
*Progress of the World Farm Census; Report of the House Committee on Flood Control; The New Laboratory Building at Columbia University; Summer Work of Harvard Geologists; Committees of the American Engineering Council* 89

*Scientific Notes and News* 91

*University and Educational Notes* 95

*Discussion:*
*Priority in Stratigraphic Nomenclature:* HERBERT P. WOODWARD. *Did John Napier Invent Logarithms?* PROFESSOR G. A. MILLER. *Dinosaur Tendons:* DR. ROY L. MOODIE. *Lactation vs. Improved Growth in Stock Albino Rats:* PROFESSOR ARTHUR H. SMITH and WILLIAM E. ANDERSON 96

*Special Correspondence:*
*Stanford University Scientific Expedition:* LIONEL WILLIAM WIEDEY and WILLIAM W. VALENTINE 99

*Scientific Books:*
*Steinmann's Geologie von Peru:* PROFESSOR EDWARD W. BERRY 100

*Special Articles:*
*On the Incidence of Infection with Intestinal Protozoa:* DR. DAVID CAUSEY. *Chemical Treatment to Shorten the Rest Period of Sugar Maple Trees:* DR. C. G. DEUBER and P. R. BOWEN 102

*Science News* x

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

## SOME PROBLEMS OF COSMICAL PHYSICS, SOLVED AND UNSOLVED[1]

By LORD RAYLEIGH, F.R.S.

OF the activities of our section, the Cape has perhaps been more identified with astronomy than with any other branch. In the middle of the eighteenth century, when exact astronomy of the southern hemisphere may be considered to have begun, there were few, if any, other places in a considerable southern latitude where an astronomer could work in safety with the necessary help of trained artisans. This tradition worthily begins with Lacaille (1750–51). Other landmarks were the foundation of the Cape Observatory (1821), the expedition of Sir John Herschel (1833–38) and the forceful and energetic career of Sir David Gill, who was the life and soul of our organization on its visit to South Africa in 1905. Shortly afterwards he retired, and I then had the privilege of friendship with him in London. Indeed, I have taken these few facts and dates from the copy of his "History of the Cape Observatory," which he gave me very shortly before his death. Although past his prime at the time I knew him, he was still vigorous and keenly interested in scientific developments, though if one brought anything new to his notice a severe cross-examination as to the validity of the evidence had to be faced.

It is partly on account of this association of South Africa with astronomy that I have chosen to lean as far towards this direction as I feel able, and to pass in review some subjects lying on the border-line between astronomy and physics.

After the first period of success in identifying the origin of the spectral lines of the sun and stars with

[1] Address of the president of Section A—Mathematical and Physical Sciences, British Association for the Advancement of Science, Cape Town, South Africa, July 24, 1929.

terrestrial materials, certain outstanding cases remained which were obviously important but in which the identification could not readily be made.

The first of these cases to yield was that of helium, which was unraveled while some of the pioneers in astronomical spectroscopy were still active. Although in my youth I was privileged to see the discovery of helium at close quarters, I shall not go back so far. When we hear of the gas being used in millions of cubic feet for inflating large airships, we have to realize that its discovery is an old story.

Kindred to the hypothesis of helium, so triumphantly vindicated by terrestrial experience, were the hypotheses of nebulium, geocoronium and coronium. The problems epitomized by the two former words have now been solved, though the solution has taken quite a different turn from what was expected by the older generation of astrophysicists.

### The Nebular Spectrum

In the nebulae are spectrum lines which have never been observed terrestrially. These are not faint members of otherwise complex spectra, such, for instance, as we have in nearly all remaining unidentified lines of the solar spectrum, but they stand out, bold and challenging, on a dark background, presenting a puzzle that was the more intriguing from its apparent simplicity. According to spectroscopic experience, now made precise and rational, simple spectra are due to light elements. This, taken with the fact that lines known to be due to hydrogen and helium accompanied the nebular lines, strongly suggested that they too were due to light elements of the class which terrestrially are known as permanent gases. But the fact remained that no one had succeeded in observing them in the laboratory, and as time went on the originally convenient resource of relegating them to an unknown element had become less convenient. For the scheme of the elements became definite, and there was no room in it for new light elements. This was one of the many cases in science where the method of frontal attack has been exhausted in vain. More systematic knowledge of spectra in general, and of the spectra of the light elements in particular, was wanted before the question could be resolved.

The clue was afforded by the circumstance that important nebular lines occur in pairs, obviously associated by their closeness and their constant relative intensity in different nebulae and in different parts of the same nebula. The consideration of such pairs or multiplets has more than once proved an advantageous point of attack on spectroscopic problems. It was in this way that Hartley, examining the diffuse triplets of magnesium, first established the constancy of frequency intervals, thus suggesting for the first time that addition and subtraction of frequencies was the proper method of analyzing spectra—an idea which appeared at that time sufficiently paradoxical. Again the recognition of the frequency intervals of multiplets afforded the clue by which complex spectra such as manganese and iron were first unraveled.

It is found then that the frequency difference of the green pair of lines originally discovered by Huggins, and known as $N_1$ and $N_2$, is 193 waves per centimeter. I. S. Bowen, to whom we owe the final elucidation of this enigma, sought for an equal interval in the spectrum of doubly ionized oxygen which he was analyzing and found it in the interval between the low-lying levels designated as $I^3P_2$ and $I^3P_1$.

This is hardly enough in itself to establish the suggested origin; to do that it is necessary to fix, not only the interval between the nebular lines, but their position as well. The lines were attributed to intercombination between one singlet upper level and two lower levels belonging to a triplet, the third being excluded by the rule of inner quantum numbers. To fix the differences of the terms concerned it was necessary to connect the singlet and triplet levels by an intercombination line observed in the laboratory spectrum of doubly ionized oxygen. This was done by A. Fowler, who, combining Bowen's laboratory data with his own, was able to get a fairly satisfactory check on the observed position of the nebular pair. Practically no doubt remains, in view of the fact that other less well-known nebular lines can be similarly explained as due to singly ionized nitrogen and singly ionized oxygen.

The identification of these lines was made by ignoring so far as convenient the rules of the quantum theory which had been evolved from laboratory experience, and given some theoretical basis by Bohr and his followers. These rules forbid certain lines which might occur according to the combination principle. When a state of excitation of the atom is such that it can not directly pass to a lower state without breaking one of these rules, that state is called metastable; and this is the case which we have in the nebular lines. I shall return presently to the consideration of metastable states and "forbidden" lines.

### The Auroral Spectrum

The next cosmical problem I wish to refer to is the long outstanding one of the green line of the aurora. This was first seen by A. J. Ångström at Upsala in 1868, and he recorded the observation in one of the supplementary notes at the end of his great paper in which an extensive scale of wavelengths for the solar spectrum was first established. In this case the enigmatic line is even more isolated than in the case of the nebulae, since, except in the case of unusually bright auroras, one can see nothing

else in the spectrum at all. For some years I took every available opportunity of looking at this spectrum, and never did so without a deep sense of mystery. The origin of the line was not in this case in the depths of space, but in our own atmosphere at the distance of a short railway journey from the observer. Yet an apparently exhaustive study of the spectra to be obtained from terrestrial gases by the combined efforts of very many experimenters gave no clue to its origin.

As is well known the clue was eventually found by McLennan, who was able to produce the line by heavy electric discharges in a mixture of oxygen and helium, or, better, oxygen and argon. Oxygen is essential, and there is now no doubt that the aurora line is an oxygen line, but the function of the inert gas is not very clear, though various more or less plausible guesses may be made. To have established that the line is due to oxygen is an immense step forward. There is, however, yet more to be done, for we do not know how to get the green line alone or with only the negative nitrogen bands as we see it in the sky. In the artificial spectrum the ordinary oxygen lines and the lines of the inert gas, helium or argon as the case may be, are conspicuous.

The wave-length of the auroral line could not be foreseen or calculated from our present knowledge of the arc spectrum of oxygen. In this case we have only a single line to deal with, and are thus without the invaluable clue afforded in the case of the nebulae by the frequency separations of a doublet or triplet. There is, however, no difficulty in finding a conjectural place for it in the scheme of the oxygen arc spectrum as given by Hund's theory. This theory, which may be regarded as a generalization of all our knowledge of line spectra, affords a kind of frame into which we may confidently hope to fit new empirical knowledge as it accumulates.

McLennan, arguing from the fact that nitrogen bands do not appear in the spectrum of the night sky, which, however, shows the green line, takes the excitation potential as less than 11.5 volts. This condition excludes very many possibilities. Indeed, if we are to be bound by the selection rules, it excludes *all* the possibilities. So with the example of the nebulae before him, McLennan waives these rules, and assigns the green line to a transition from one or other of the low-lying metastable states which the theory indicates.

The lowest state of all should be a triplet, and owing to the absence of companions to the green line this may very probably be excluded.

If so, only one alternative remains, and the successful determination of the Zeeman effect carried out in McLennan's laboratory is in harmony with the choice so arrived at. An independent investigation by L. H. Sommer, published immediately afterwards, covered exactly the same ground and led him to the same choice. This is satisfactory so far, but the position will be much strengthened and consolidated when we have an independent determination of the levels in question, giving the means of calculating a theoretical wave-length for comparison with that observed. To do this will require a fuller survey of the Schumann region of the arc spectrum than has yet been made. For the aurora line we have the experimental production from oxygen but not the numerical spectroscopic relation. For the nebular lines our position is exactly the reverse.

The origin of the green auroral line has thus been definitely cleared up, at all events in so far that it is attributable to the arc spectrum of oxygen. There are, however, other features of the auroral spectrum which are still obscure. I will limit myself to discussion of one of them—the red line of the aurora. Red auroras are comparatively rare, and when they do occur the distribution of color presents very curious features. In some cases the ends of the streamers are tipped with red, while the greater part of the length is green. The only reddish aurora which I have been privileged to observe at my home in the south of England (May 14, 1921) was of a different character, the color ranging rapidly through various shades of purple. The light was distributed in irregular patches high up near the zenith, though predominantly in the north. At the same time its position was highly unstable, and the general impression produced was reminiscent of high potential discharges in highly exhausted vacuum tubes. Vegard has described cases where the whole sky suddenly turned crimson. He has obtained good small-scale spectrograms of the red line, which give the position as $\lambda 6322$, which, however, is subject to a probable error of at least $\pm 1A°$. A determination by V. M. Slipher, of the Lowell Observatory, gave $\lambda 6320$.

So far as can be judged from the evidence available, no pair of the low-lying levels of the oxygen arc scheme which McLennan has discussed in connection with the aurora are suitably placed to yield this red line by combination. We naturally turn to the consideration of nitrogen spectra, which, as is well known, are represented in the blue and violet regions of the auroral spectrum.

I described in 1922 a spectrum in which one of the first positive bands of nitrogen $\lambda 6323$ was very much intensified relative to the neighboring red bands, which ordinarily are of comparable brightness. This spectrum was produced by adding a large excess of helium to the nitrogen afterglow, and the source had a visual red color dominated by this band. In describing this

work it was suggested as a possibility that this was the origin of the red auroral line, and somewhat similar ideas have been revived by McLennan in his recent Bakerian lecture. But there are difficulties to be met. Photographically two yellow nitrogen bands come in with intensity equal or superior to the red one, and these have no counterpart in auroral spectra. Moreover, the wave-length data for the red auroral line are far from being accurate enough for an identification depending on a single coincidence only. One of the most urgent problems in auroral work is an adequate wave-length determination of this red line from a large-scale spectrogram.

### CORONIUM

A problem which has generally been classed with those we have been discussing is that of the lines in the sun's corona, attributed to a hypothetical coronium. In the light of our present knowledge it is not probable, perhaps we may say not possible, that an unknown element coronium exists. Attempts have not been wanting to identify these lines with known elements. The latest is by Freeman, working in the Ryerson Laboratory of Chicago, who seeks to attribute the lines to argon. He thinks, for instance, that the strong visual green line, from which the conception of coronium arose, may result from two different transitions in the argon atom, being in reality double. One of his proposed transitions would give the fifth line of a possible series, and the other the ninth member of an actual series. But none of the earlier members of either of these series is seen in the corona, and this seems fatal to the identification proposed. We could not assign an observed line at $\lambda 3771$ as $H_\iota$ (H iota) if $H_\alpha$, $H_\beta$ and $H_\gamma$ and the other earlier members of the series were missing, yet this would be an analogous case.

I think we must consider the origin of the strong lines of the corona as an unsolved problem. The possibility of their being in reality heads of molecular bands must be kept in view.

### EXCITATION OF THE VARIOUS SPECTRA

We have discussed these cosmical spectra so far chiefly from the standpoint of the spectroscopist. It will now be of interest to consider the probable mode of excitation of some of them.

Let us consider first the polar aurora; this, as is well known, is closely bound up with exceptional conditions of magnetic disturbance, and these in turn are conditioned by solar influence. As regards the nature of this influence, the theory of Birkeland, elaborated by Störmer, still holds the field. The sun was regarded by them as emitting localized streams of electrically charged particles from limited areas of its surface.

The unrivaled advantages of this theory are that it allows the solar action to be emitted in a highly specialized direction, thus accounting for the sudden commencements of magnetic storms all over the globe, and their tendency to recur after the twenty-seven days of a solar rotation have passed, and further, that by the earth's magnetic field the action can be got round to the night side of the earth. But this theory in its original simplicity has required a good deal of patching, and it is difficult to feel much satisfaction with the special *ad hoc* hypotheses which have had to be introduced into it.

A stream of particles with a charge of one sign only is open to the criticism, first put forward by Schuster, that the stream will dissipate itself by electrostatic repulsion, and loses the hard outline which is one of the most essential features. Lindemann has proposed to get over the difficulty by making the stream neutral on the whole, still consisting, however, of charged particles of both signs. Here, however, we lose too much of the magnetic flexibility of the stream. Chapman proposes to retain a slight excess of charge of one sign, and in this way is able to arrive at a tolerable compromise. But one feels that more experimental guidance is badly needed before we can venture with confidence into these theoretically dark regions. The search for direct evidence might not seem at first sight very hopeful, but not long ago a sensational suggestion was made by Störmer. His attention was drawn by Hals to echoes heard after short-wave (131 meters) wireless signals sent out from Eindhoven in Holland. These echoes have been found by Störmer and Hals at long intervals up to as much as fifteen seconds after the original reception.

Now, if we bear in mind that with the velocity of light the longest terrestrial distances only give intervals about one seventh of a second, it seems inevitable that some extra-terrestrial reflector should be looked for. Störmer finds this in the corpuscular stream as bent round by the earth's magnetic force. Though the boldness of the idea is staggering, it is difficult to suggest any alternative view. Störmer states that "the variability of the phenomenon indicated by the observations agrees well with the corresponding variability of aurora and the magnetic registrations."

T. L. Eckersley has made an observation on electrical disturbances of natural origin which he interprets as analogous to Störmer's. A click is heard in a telephone attached to a large aerial, which is followed at an interval of about three seconds by a "whistler" or musical note of short duration. Further whistlers follow at intervals of 3.8 seconds, each more drawn out than the previous. The musical notes are regarded as due to the spreading action of a dispersive medium on an electrical impulse. It is only

at times of magnetic storm that these phenomena are frequent.

Further development of observations of this kind will be awaited with keen interest.

To return to the nebular spectrum: although the main problem has been cleared up in the way described, it would still be an important step to imitate the spectrum in the laboratory, not so much to confirm the origin of the lines as to get direct information about the conditions under which they may be excited. No success has yet been obtained in this direction, but it is fairly clear how the attempt should be made. We must have conditions capable of exciting the lines of doubly ionized oxygen and attempt to work in a large volume at high rarefaction.

A large volume and high rarefaction (rarity of collisions) is suggested by the nebular conditions, and was plausibly held by Bowen to be an essential. It must be allowed, however, that such experimental evidence as we have at present on passage downwards from metastable states does not definitely point in this direction.

In such attempts what Darwin called "fool experiments" and what prospectors for oil call "wild-catting" are not to be discouraged. Indeed, many of the most fruitful discoveries are really made in this way. The logic is put in afterwards. That is what happened in the case of the three-electrode thermionic valve.

Thanks to the work of Wright, Hubble and others the source of excitation in the bright line nebulae no longer appears inexplicable. We have the cardinal fact that in nearly all cases stars of early type, capable of affording radiations of high frequency, are involved in the nebulae. The two or three apparent exceptions, though deserving of the closest scrutiny, do not at present seem to have enough weight to upset a generalization which rests on a great number of cases. It is true that we can not observe these short waves, the maximum of intensity in the spectrum being hidden from our view by the layer of ozone overhead, of which I shall say more presently. But we can confidently infer their existence by extrapolating from what we can see and correcting for what we know of atmospheric absorption. The cases of some of the central nuclei of the planetary nebulae are specially satisfying from the definite relation of the star to the nebula and the adequate character of the star itself. W. H. Wright, writing in 1918, before these views had emerged, and without any thesis to maintain, expressed himself as follows:[2]

> I can not but believe that this wonderful richness in ultra-violet light which gives the spectra of nebular nuclei their characteristic appearance, in spite of the great difference which they exhibit in the matter of bright bands, is the dominating peculiarity which must be regarded as the distinguishing mark of this group of objects.

[2] Lick Observatory, vol. xiii, p. 252, 1918.

It has been suggested that the general penetrating cosmic radiation of which we have heard so much of late stimulates the nebular spectrum, but upon the facts available this hypothesis hardly seems necessary or helpful.

### THE DARK PATCHES IN THE NEBULAE

There is another aspect of the diffuse galactic nebulae which remains obscure in more senses than one. It is seen to special advantage in such objects as the "trifid" nebulae in Sagittarius. Dark regions are, as it were, interlarded with the bright ones in a way which strongly suggests that we have to do with complementary aspects of the same phenomenon somewhat in the same way that, for instance, the emission of a fluorescent body is connected with its absorption. Yet it is very difficult to pursue this line of thought into satisfactory detail. The opacity is quite unrelated to the emission, and indeed it presents the baffling peculiarity of having no peculiarity. For apparently every part of the spectrum of the stars lying beyond is obscured in the same ratio. Experimenters in the field of optics know how difficult it is to secure a result of this kind in the laboratory, particularly when the ultra-violet spectrum has to be included.

Even fairly opaque gases like iodine vapor which are at our disposal show markedly selective absorption, and in terrestrial experiment recourse is usually had to the partial action of a solid obstruction such as a spinning sector or a wire gauze not seen in focus. The astronomical equivalent of these devices is a swarm of meteorites, and it may be necessary to invoke their aid, but the rare gaseous atmosphere required to give the line spectrum of hydrogen, helium, nitrogen and oxygen can not be considered to blend harmoniously with a swarm of meteorites or to have anything like a complementary relation to it, and it is particularly difficult to understand from this point of view how it can come about that the bright nebular lines are often seen on a profoundly dark background almost or quite free from continuous spectrum.

### COMETS

A kindred problem is that of the luminosity of comets. This has been discussed by Zanstra in a recent paper.[3] He takes the view that the Swan bands of carbon are resonance bands excited by light from the sun in the visual spectrum, the gases being at an ordinary temperature such as prevails at the earth's surface. If these are really the conditions, the prob-

[3] M. N., December, 1928.

lem of imitating the comet seems ideally easy from the laboratory point of view. The Swan spectrum should appear in absorption of suitable carbonaceous gases contained in a vessel at the ordinary temperature, and it should be observable in lateral emission. I can not help thinking that if nothing more than this was necessary, the thing would have been done before now. In the case of the D line sodium, treated by Zanstra as quite analogous, it has of course been done long ago in the phenomenon described by R. W. Wood, and called resonance radiation.

### METASTABLE STATES

In discussing the nebular and auroral spectra, we encountered the idea of "metastable states." At present this conception is not in a very satisfactory condition. The original idea was of a state which did not allow of direct transition by emission of radiation to the stable ordinary state. Let us compare the level of the atom to the stories of a building and the optical electron to a man inside the building. The ordinary state of the atom is represented by the man being on the ground floor, and the metastable state by placing him on the first floor. But the internal architecture of our building must be pictured as peculiar. A staircase connects the first floor with the second floor, and another staircase connects the second floor with the ground floor: but there is no connection between the first floor and the ground floor except by going up higher and coming down again.

Such, I say, was the original conception, but facts which have since come to light require some revision of it.

In the nebulae the electron manages somehow to escape from its prison-house, and descend to the level below not by the legitimate route of going upstairs and down again, but by illicitly breaking through the floor, contrary to the rules of the establishment.

Abandoning the metaphor, and the attempt to use popular language, the selection rule which forbids transitions not involving a change in the azimuthal quantum number is violated in all such cases. The inner quantum number rule, which requires that the inner quantum number should not change from 2 to 0 or from 0 to 0 is also violated in one class of cases, and rather meticulously observed in another. This rule permits only the pair of green nebular lines in doubly ionized oxygen which we have discussed; and in deference to it only two are observed, instead of the three which apart from this might have been expected from the triplet ground state.

Yet we find the blue singlet line $\lambda 4363$ of this ion violating the same rule, and the same applies to the analogous case of the aurora line, if we adopt McLennan's view of its position in the scheme of the arc spectrum.

In the case of the mercury spectrum, which lends itself well to experimental observation and of which much detail is known, we have laboratory examples of the violation of this rule, as originally shown by experiments of Takamine, Fukuda and other Japanese physicists. The lines were originally obtained under conditions where a strong electric field was acting, and this was sometimes urged in mitigation for breaking the rule. Again, the lines were of low intensity, and this too was thought to be a partial excuse.

Whatever might have been thought of these apologies originally their irrelevance was, I think, clearly shown in some experiments of my own, in which one of the "forbidden" mercury lines was obtained as the second strongest line in the entire mercury emission spectrum, in the vapor passing through a discharge, but altogether away from the region in which the discharge itself was taking place, and consequently in the absence of an extraneous electric field.

In another experiment I was able to obtain the other forbidden line as an absorption line in unexcited mercury vapor, and thus apparently in the absence of any disturbing conditions. In this experiment the quantity of vapor used was very large, about ten million times the amount required to bring out the resonance line of mercury in absorption. The probability of the transition thus indicated is very low, and for the other forbidden line it is apparently still lower. But for all that, as we have seen, this forbidden line can be got in considerable intensity in emission. The necessary condition in the mercury experiments appears to be a large accumulation of mercury atoms in the relevant metastable state, so that even with a low probability of transition for the individual excited atom a considerable number of transitions occur.

It has even been proposed to define a metastable state as one with a low probability of transition. This takes us far from the original conception, and makes "metastability" merely a question of degree. Some recent results which I hope to bring before the section at a later stage in our proceedings seem to indicate that even the normal excited state may possibly persist for a much longer time than has hitherto been supposed. If this conclusion is accepted, a far-reaching revision of our present notions may become necessary. The general softening of outline in our picture of atomic events resulting from the substitution of wave groups for particles seems likely to afford what is required and to allow the occasional transition downwards from a metastable state.

### OZONE

The case of the nebular spectrum affords an illustration of how spectroscopic theory, working on laboratory data gained in the remote ultra-violet region, enables us to some extent to turn the difficulties which arise from our inability to examine this region in celestial spectra. The veil of atmospheric ozone overhead cuts off the spectra of the sun and stars and thus hides much of the ultra-violet, constituting a great obstacle to astrophysical research. On the other side of the account we may remember that it protects our persons from the harmful ultra-violet rays, and that without it we might not be here to conduct research at all. It has been suggested by Cario, R. W. Wood and others that on the view that atmospheric ozone is generated by the absorption of short wavelengths in the sun's spectrum, it may be absent in the Arctic during the polar night. This possibility has been put to the test by Rosseland, but with negative results. It is doubtful whether his station was far enough away from the sunlight to make his result absolutely final. But other omens are unfavorable. Thus Chalonge has found that the amount of ozone present in the night (using the moon as a source) is notably more than by day; and Dobson, Harrison and Lawrence have found that when the meteorological conditions are such as to bring air from the Arctic, the ozone content goes up, and that this is particularly marked in spring, when the Arctic has been without sunlight for months. The point is, however, of great interest in itself, and makes the question acute of how the ozone is generated. For in view of these facts it seems hard, as Dobson has pointed out, to regard it as the product of the sun's ultra-violet radiation.

No search seems yet to have been made for ozone in the planetary atmospheres. In the cases of Mars, Jupiter and Saturn, at all events, the problem is not at first sight specially difficult. It would not be easy to establish a positive result, however, unless the atmospheres of these planets possess an ozone stratum at least comparable in effective thickness with the terrestrial one.

### POSSIBILITY OF UNKNOWN ELEMENTS OF HIGH ATOMIC WEIGHT

Although we are no longer at liberty to postulate unknown light elements, we are free up to the present to postulate heavier ones than any known terrestrially. Jeans, as is well known, has made use of this hypothesis to explain the origin of stellar energy. In common with other authorities he provides it by the destruction of matter, with radiation of the equivalent quantity of energy ($MC^2$) demanded by the theory of relativity. So far there seems to be fairly general agreement. The difficulties arise when we come to the question of stability, and here agreement is not general. Jeans considers that the source must liberate energy at a rate independent of the temperature. I am not qualified, and shall not attempt, to discuss this point. The object of postulating unknown heavy elements is to endow them with the property of going out of existence spontaneously at a rate which is independent of external condition, except in so far as ionization, which involves the removal of some of the electrons from the neighborhood of protons, tends to hinder the process.

In the known radioactive elements we have, of course, instances of unstable forms of matter, and Jeans regards these as transitional, but it must be admitted that substances which undergo spontaneous disintegration do not at first sight form an altogether satisfactory halfway house between those which are quite stable on the one side and those which spontaneously go out of existence on the other. Then we have to explain why these heavy atoms are not found on the earth, which, it is generally agreed, originally formed part of the same mass as the sun. Jeans mentions this difficulty, and gives reasons for thinking that the heavy elements would sink to the interior of the mass, so that the earth, formed from the exterior part of it, would not contain them. That a *vera causa* is here appealed to can not be doubted, but there seem to be some difficulties in assuming that it operates with enough precision to secure the desired result.

The list of known elements ends with uranium, and we must notice that the occupants of the ninety-two places up to and including uranium in the list nearly all answer to their proper numbers when the roll is called. The only exceptions are 85 and 87. And he would be a rash philosopher who attached much importance to these vacant places, which may be filled up any day. Roughly speaking, we may say that the elements up to uranium are all present, and the higher members assumed to exist in the stars are all absent. It is putting a heavy burden on the mechanism of gravitational separation to expect it to achieve this result. The inventors of ore-dressing machinery would, I should imagine, despair of accomplishing anything like it.

Nature works on a vast scale and with plenty of time at her disposal, and it may well be urged that we must be careful of measuring her possible achievements by our own. We may ask, however, whether the more direct indications available suggest that she has in fact made this separation. If there is this cut between the atomic numbers 92 and 93, we should expect most of 92 to have gone into limbo in order to

ensure *the whole* of 93 having done so. Yet 92 (uranium) is a relatively abundant element compared with most, being in fact number 25 on the list of abundance in igneous rocks, according to the estimate of Clark and Washington. Again, we happen to be in a position to say that on the earth, at least, uranium, so far from having sunk to the center, is concentrated near the surface. This is inferred from the known outflow of heat from the earth, which is difficult to reconcile with the observed amount of radioactive matter near the surface and impossible to reconcile with the existence of a comparable amount in the interior.

Assuming that uranium exists on the sun as on the earth, then, as first pointed out by Lindemann, there are strong grounds for thinking that it must be in course of formation there, for the life of uranium is too short in comparison with the probable age of the sun to allow us to suppose otherwise. Those who remember the early development of radioactivity will recall that a parallel argument was successfully used by Rutherford to prove that radium must have originated on the earth before the fact was directly proved that it is being generated here. Radium (it was later shown) is generated from a parent body of higher atomic weight, namely uranium. Jeans would regard the origin of uranium itself as analogous, and if this analogy is accepted it would require the presence of an element of still higher atomic weight, capable of undergoing radioactive disintegration, but, it is to be observed, incapable, *ex hypothesi*, of dissolving entirely into radiation.

No doubt these are very deep waters, and we can hardly expect at present to fathom them. What would really be most helpful would be a theory of atomic structure in sufficiently definite agreement with experiment as regards known elements to enable us to proceed to investigate the properties of elements of higher number than 92 with confidence. On the general question of whether the evolution of elements has proceeded from the simple to the complex, or from the complex to the simple, it does not seem to me very much to the purpose to appeal to evolutionary doctrine and the analogy of organic evolution, in favor of the former alternative. Is it not more to the point that the only cases we can observe (radioactive changes and those induced by radioactive bombardment) are of the latter class? At present this is a question of scientific taste. Perhaps it is not irrelevant to remark that even in organic evolution degeneration of organisms sometimes occurs, and I do not know whether our biological colleagues are in a position to assert that the whole course of organic evolution may not at some future time be reversed by a change of conditions. At all events, it is something to have formulated the more restricted question of whether uranium now comes into being on the sun by a synthetic or an analytic process. It would seem that this is a well-framed question, and that the answer can hardly be either *both* or *neither*.

## CONCLUSION

The great success of theoretical investigations in recent times naturally leads enterprising spirits to use them not only in interpreting what we know or can verify by observation, but to lead us into regions where experiment is not available as a check. I believe that this does nothing but good in times like ours, when there is no danger of the doctrines even of a master being unduly pressed, if the evidence of observed fact turns against them. At the same time, we must not expect too much of pure intellect unchecked by observation. Theories that do not stand the test of time pass for the most part into complete oblivion, and we are apt to forget how appallingly large a mass of wreckage the total of them represents. The next generation remembers chiefly those that survive, and does not take full advantage of the lesson of how easy it is for an apparently inevitable conclusion to be wrong. Unless the argument carries its own verification by some accurate and previously unforeseen numerical coincidence, it is hard indeed to tell if we are on the right track.

Though some of the problems we have been discussing have been only partially or not at all resolved, yet many possible points of approach are opening to our view.

The attack on nature's secrets is now conducted along a long line of battle. No sooner does the defense show signs of crumbling at any point than an eager crowd of combatants, not restrained by any undue respect for the traditional modes of scientific thinking, are ready to throw themselves into the breach. The great array of trained workers in pure science existing in the modern community is powerfully reinforced by workers in applied science, who are backed by the resources of the industrial and financial world and hand back to the physical laboratory the devices which had their birth there in a form infinitely strengthened in power and convenience of application. Thus rearmed with weapons of greater power and precision, pure science advances again to the attack of fresh territory, and so the process goes on at an ever-accelerating rate. How long this acceleration is destined to continue it is impossible to say. It shows few signs of abating at present. But for all that I for one am not afraid that our successors will be able to complain that we have left them no more worlds to conquer.

# THE DECLINE IN THE AVERAGE LENGTH OF LIFE

By Professor C. H. FORSYTH
DARTMOUTH COLLEGE

IT is the purpose of this article to take issue with those who are so elated with results obtained in their own immediate fields leading to significant reductions not only in certain death-rates but also in the prevalences of certain diseases that they feel justified in predicting marvelous increases in the average length of the whole of life in the no great future. Most of these optimistic authorities have failed to appreciate that practically all these results have been attained in children's diseases and that little or no attention has been given to the situation at ages beyond the prime of life. The writer claims that conditions in this country at advanced ages have been on the down grade ever since the first mortality records were established at Washington and that they have now reached such a pass that all the great gains at the early ages are already more than offset by the losses at advanced ages. In brief, evidence will be offered in this article to show that the average length of life in this country is now actually decreasing.

It is out of the question to try to present, in this short article, all the statistical evidence to support the writer's present contention, but it is planned to offer most of the evidence later in a much longer article. Over forty mortality tables were constructed to yield not only the results portrayed in this article but also all possible results which would have a bearing upon the results presented here. A thorough search was made for any result which would seem to throw any doubt upon the conclusion drawn here—that the average length of life in this country is decreasing—and the search was in vain.

It is most momentous and almost inconceivable that a civilized and even highly prosperous nation should have a decreasing average length of life. The decrease proved to be very pronounced in the state of New York, and at one time the writer was afraid that the large population of that state was weighting his general results too much and that, possibly, the results obtained for the states investigated were due wholly to New York. However, an investigation omitting the state of New York led undeniably to the same conclusion. An investigation of the whites of native parentage pointed to the best probable results but could not be completed satisfactorily because of a recent change in classification in the federal records.

The main results, shown here, were obtained from abridged mortality tables constructed from the population and mortality statistics of the males of what are now known as the original registration states —the New England states and Indiana, New Jersey and New York—or the only states which have supplied satisfactory records of deaths ever since 1900—and even 1890. The results are given only in graphical form—not only to save space but also to emphasize *trends* rather than absolute results. The graphs for 1890, 1900, 1910 and 1920 represent the results of previous articles in SCIENCE[1] in which attention was called, for the first time, to the fact that the average length of life was increasing in this country—and this is the important point—in spite of *increasing* losses at advanced ages.

As the census is taken only once in ten years, the populations for the individual years since 1920 were interpolated by fitting the well-known Pearl-Reed formula to the total populations of the males and females—separately—of the ten original registration states for 1890, 1900, 1910 and 1920. These interpolated populations were then distributed—for each sex—into ten-year age groups in the proportions existing in 1920. The mortality statistics, of course, are collected each year, but the data for 1926 and 1927 had to be obtained from Washington in manuscript form.

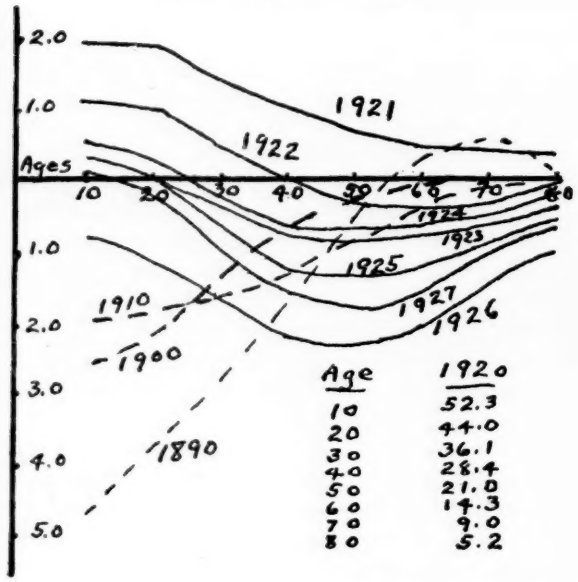
The results for the females are not given here but present the same picture—in somewhat less smooth form.

It will be understood, of course, that there is an average length of life corresponding to each age—the average length from that age on—although it is usually called the expectation of life in that case. In working with abridged mortality tables it is necessary to omit the first few ages—say, before age ten—for well-known reasons, but the expectation at age ten is usually a rough approximation of the average length of the whole of life.

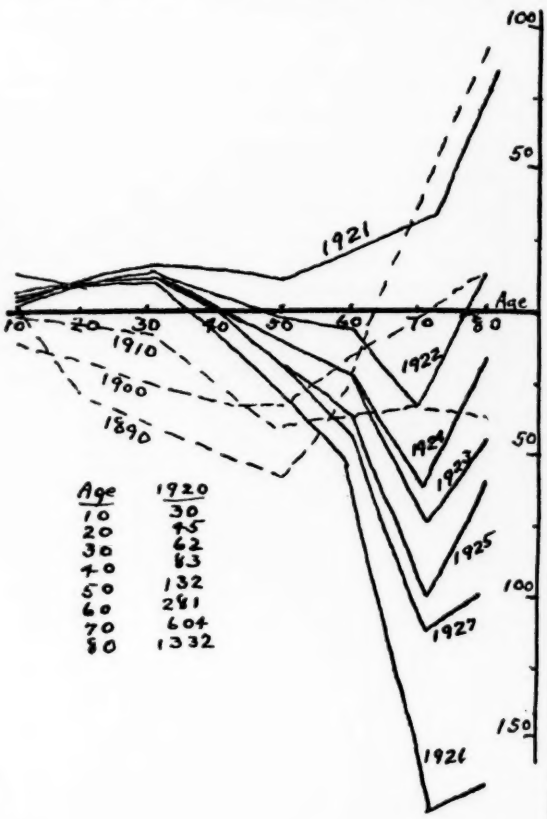
Let us examine the graphs of the (male) expectations of life. After considerable experiment it was found more illuminating to portray not the expectations but rather deviations of the expectations, say from those of 1920, by ages. This holds also and especially for the portrayal of the death-rates. It will be seen that during the thirty years from 1890 to 1920 the expectation of life at age ten—and therefore approximately the average length of life—increased markedly. Compared with the great increases at age ten, the later intersections of the curves and their fairly complete reversal in order at the higher ages, taken for this period alone, do not stand out very

[1] July 7, 1916; March 23, 1923.

EXPECTATION OF LIFE—MALES
(DEVIATIONS FROM "1920")




DEATH RATES PER 10,000—MALES
(DEVIATIONS FROM "1920"—PLOTTED UPSIDE DOWN)




strongly, although the writer believed them to be significant from the start and so expressed himself in the article of 1916 cited above.

The results for 1920—the horizontal base line—proved a little disconcerting to the writer for a time, for that year showed not only unexpected improvement at the early ages but also fairly satisfactory conditions at advanced ages. The abnormality of year 1920 should have been appreciated at that time, however, because we were just recovering from the pandemic of "flu" of 1918 when the general death-rate jumped back up temporarily to where it had been about twenty years before, and the improvement of 1920 (and 1919 and 1921 as well) could have been easily explained as a natural reaction to conditions in 1918.

Every one has been familiar with the consistent improvement of conditions at earlier ages and some have been more or less aware of the situation at advanced ages, but there is no printed evidence that any one was sufficiently aware of the seriousness of the latter situation to propose the pertinent question of whether the latter situation would ever develop to the point where it would dominate. In any case, the question is no longer pertinent—the decline at advanced ages already dominates and the average length of life—or at least the expectation from age ten—is already going down. The curves for the individual years 1921 to 1927 inclusive tell their own story. The order of the curves is not exactly regular, but who can doubt the significance of the general trend? It will be noted that the expectation from age forty-five or fifty on is the lowest of which we have any record—far lower than it was even forty years ago—and it is still going down, not up.

Values of the expectation of life are very valuable in measuring the true relative effects of the various gains and losses at different ages, but the basic death-rates are the data which enable us to *locate*—with respect to age—any serious trouble. If we refer to the graphs of the death-rates—or rather, the corresponding deviations from "1920"—it will be seen that the changes in death-rates previous to age thirty are not significant and although it might well be argued that little significant change could be expected in a short period of only seven years, by the same logic the changes in the neighborhood of age seventy are tremendous. It is well to recognize that improvement at the early ages has a rather definite limit and that the decline at advanced ages has no appreciable limit. It follows naturally that with all the improvement in the world at the early ages the present downward trend at the advanced ages, if unchecked, will continue to dominate and produce a greater and greater net decline in the average length of life.

The great decline at advanced ages is remarkably concentrated about age seventy although it extends as

far back as age forty. In fact, the definiteness and consistency of all the writer's results were truly remarkable when it is recalled that each result—even in the same group—was obtained independently of every other; no smoothing process was used anywhere in the whole investigation—except what was naturally involved in interpolation.

To paraphrase the words of a contemporary humorist, all that I know is what the various statistical data tell me, but, to me, the whole picture, from our earliest records in 1890 to the present time, points consistently and inevitably to a future of a declining average length of life until the American adult wakes up to the fact that the odds are at present heavily against his living as long as his father or grandfather. Some will say—and no doubt truly—that it is all a natural consequence of the great drift to the cities. Others will go farther and say life has become too fast and strenuous and that we do not know as yet how to adjust ourselves to such a life. To the medical authorities the whole problem will loom as one of relieving the strain upon the heart. But little will be accomplished until the American adult himself is duly informed and made to realize that he is in the midst of a decidedly losing fight and that the situation will continue until he applies himself energetically to be superior to his environment. Moreover, each adult must fight his own individual battle, since he usually brooks no interference with his own individual mode of living. Medical authorities and scientists can be depended upon to care for the children and their diseases, but they have little or no chance to interfere with the lives of adults.

It truly looks as if it is going to be a losing fight for some time to come, for although some adults are making a commendable effort to live sane lives the vast majority seem very indifferent and many give apparently no thought whatever to habits which they clearly know are bad and which they know they could easily discard. There is surely no worse influence than that wielded by well-meaning authorities who go around airing their ill-founded beliefs that all is going well and that before long everybody is going to be living seventy-five to a hundred years!

The present recurrence of the "flu" promises to obscure the issue, not only by a further abnormal decline but even by the later reaction or recovery which is pretty sure to occur and which is very apt to produce a false impression of security and health improvement.

# OBITUARY

## SIDNEY SAVORY BUCKMAN, 1860–1929

SIDNEY SAVORY BUCKMAN, British paleontologist, passed away at his home at Thame in Oxfordshire, England, on the 26th of February, 1929. He was born in 1860, the son of a naturalist and geologist, James Buckman, who will be remembered as the venerable professor at the Royal Agricultural College at Cirencester. Sidney Buckman was early led to take a strong interest in the paleontology and stratigraphy of the British Jurassic. In these fields he was one of the most active and brilliant of investigators throughout his life. His passing is the fall of a leader.

Buckman's first scientific paper appeared in 1878, his nineteenth year. From then on his work, carried on in spite of the cares of business, was prodigious. Possessed of boundless mental energy, the keenest of keen intellects and a philosophical mind of the first order, he soon uncovered weaknesses in existing systems of interpretation. This brought him into controversial contact with the Geological Survey, a contact which produced active research on both sides, and finally a justification of Buckman. This work produced a notable result in the "Monograph of the Inferior Oolite Ammonites," 1887–1907; and it culminated in "Type Ammonites," 1909–1928, his great masterpiece.

In these memoirs, as well as in certain of his shorter contributions, Buckman's improved methods of study and his broader results were worked out. The outstanding principle in his method is his insistence on fine subdivision in both paleontological and stratigraphical analysis as the only means of bringing ultimate, significant details into relief, and of producing thereby a basis for discerning real relationships. This method resulted in a multiplication of genera and species of ammonites, for which Buckman has been adversely criticized. But at least Buckman's names stand for real groups, even though future work may modify their rank. A feature of his work is his development of the principle of classification by descent. This is the keynote of his later work, to be seen especially in "Type Ammonites" and "The Brachiopoda of the Namyau Beds" (1917–1919).

His paleontological studies soon convinced him that the simple stratigraphical principles of William Smith could be applied with much greater precision than had hitherto been attempted. This led to a great deal of stratigraphic subdivision, so that the thirty-three Jurassic zones of Oppel became elaborated into a system of about four hundred zones. Strange as it may seem, criticism of this part of the work has been much less severe. But this, as Buckman points out, is

probably because of the failure of his critics to comprehend his work: the stratigraphical subdivision is dependent on the zoological—criticisms of the one apply equally to the other.

A very important result of Buckman's work came from his recognition of a principle originally perceived by H. S. Williams—the essential independence of faunal and sedimentary history, in spite of the close, and even confused, association of the record of each in geologic formations. This demanded a dual nomenclature for the divisions of geologic time—one for stratal, one for faunal time-units. Working on this principle Buckman produced his biological chronology of the Jurassic Period, in which the period is divided into forty-five ages and about four hundred hemerae or biological time-units.

However, Buckman did not confine himself within the sphere of geology. His brilliant and versatile thought moved into such realms as human evolution, the origin of human customs, biography, philosophy. Some titles—such as, "John Darke's Sojourn in the Cotteswolds and Elsewhere," "Marriage and Mating," "Neglect of Opportunities," "Origin of Human Language," "Human Babies: What They Teach"—show, perhaps meagerly, the spheres which he touched, and touched in no dilettante spirit, but with the hand of a master. His extraordinarily detached point of view permitted his mind to travel freely along avenues of thought from which most minds are unconsciously excluded by the wall of their own prejudice and taboo.

The complete list of Buckman's printed works includes about two hundred items. A full listing and appreciation will be attempted later.

Buckman neither sought nor received honors. However, he was elected to fellowship or association with a number of learned societies both in his own country and abroad. And the value of his work was recognized repeatedly by the Geological Society of London by awards which culminated in 1913 in the Lyell medal.

C. H. CRICKMAY

UNIVERSITY OF CALIFORNIA AT LOS ANGELES

## RECENT DEATHS

THE *Geographical Journal*, London, writes, "The many friends whom he made when he came last summer to the Geographical Congress will have been shocked to hear of the untimely death of Colonel Lester Jones, director of the United States Coast and Geodetic Survey, at the early age of fifty-three, after fourteen years' tenure of that important office. He made no claim for himself to scientific distinction; but that he was a most capable director is evident from the recent history of the great organization which he controlled. The output of its scientific divisions has been immense: we look with respectful admiration and a little envy on a department of the public service which can command twenty mathematicians, and realize that even in the United States of America it can be no easy task to obtain the increasing appropriations necessary to support geodetic and hydrographic survey on such a scale. The Director who can take upon his shoulders all the cares of organization and supply, leaving the chiefs of his scientific divisions unfettered freedom to pursue their technical work, does great service to science; and this Colonel Lester Jones performed. Moreover, he was always ready to be helpful to others; he took much trouble to procure for the Society a portable tide-gauge of the U.S.C.G.S. pattern which was wanted in a hurry for the use of our geographers attached to the Great Barrier Reef Expedition, and to answer questions on an interesting point of International Boundary practice. His impressive courtesy as a delegate and kindness of heart as a colleague will be long remembered."

DR. WILLIAM HENRY CARMALT, emeritus professor of the principles and practice of surgery at Yale University since 1907, died at New Haven on July 17 at the age of ninety-two years.

DR. T. W. GALLOWAY, since 1920 associate director of the Department of Education of the American Social Hygiene Association, died on July 16 at the age of sixty-three years. Dr. Galloway was formerly professor of biology at James Millikin University and at Beloit College.

M. J. CORNET, professor in the school of mines, Belgium, and a correspondent of the Paris Academy of Sciences, has died at the age of sixty-four years. M. Cornet was the first explorer of the Belgian Congo.

A SPECIAL cable to the New York *Times* reports that Professor Hans Meyer, explorer and geographer, died at the age of seventy-one years in Leipzig on July 6 from the effects of an infection contracted during his recent trip to the Canary Islands. He was a member of the Bibliographisches Institut, publishers of Meyer's Lexikon.

THE deaths are also announced of Dr. Heinrich Micoletzky, professor of zoology at Innsbruck; of Dr. Friedrich Heincke, formerly director of the State Biological Institute in Heligoland, and of M. Daudois, professor of pathology and clinical surgery in the University of Louvain.

# SCIENTIFIC EVENTS

## PROGRESS OF THE WORLD FARM CENSUS

THIRTEEN countries in Central and South America have promised cooperation in the World Agricultural Census of 1930, reports L. M. Estabrook, director of the census for the International Institute of Agriculture, who recently returned to Washington from an 11,000-mile trip to the capitals of Guatemala, Salvador, Honduras, Nicaragua, Costa Rica, Panama, Ecuador, Colombia, Venezuela, British Guiana, Trinidad and Barbados.

The inclusion of these countries in the census brings the total representation in the project to about 97 per cent. of the land surface, 98 per cent. of the total population and approximately 99 per cent. of the total agricultural production of the world. The only countries not visited by Mr. Estabrook since his appointment as director in 1925 are Afghanistan, Persia, Bolivia and some of the West African colonies and small islands in which agriculture is relatively unimportant but for which cooperation has been promised by their home governments.

The undertaking of a world census of agriculture in 1930 was approved by the general assembly of the International Institute of Agriculture at Rome in 1924, and the preliminary work of organizing the census was made possible by the cooperation of the International Education Board, the United States Department of Agriculture and the International Institute of Agriculture. The census program and standard form of census questionnaire have been approved by the permanent committee and two general assemblies of the institute, by the International Institute of Statistics and by the Diplomatic Conference on Economic Statistics that met in Geneva in November, 1928.

The purpose of the world census of agriculture is to provide more complete, accurate and comparable international statistics relating to agriculture, to provide a secure basis for annual crop reports and statistics and to improve the agricultural statistical organization of many countries. It will be the first census ever attempted in all countries of the world in the same year and according to the same general plan. The International Institute of Agriculture, the International Institute of Statistics and the Diplomatic Conference on Economic Statistics have recommended that the agricultural census be repeated every ten years.

Mr. Estabrook reports that the Central and South American countries visited on his last tour provide a large part of the world supply of coffee, cocoa, ivory-nuts, coconuts, bananas, sugar and some other tropical products. He says there are great possibilities for agricultural development in these areas, although limited by the broken character of the country, and that progress will be slow until better roads, steamship lines and other means of transportation and communication are provided. Need is expressed also for further development in the agricultural, research and statistical departments of these countries.

## REPORT OF THE HOUSE COMMITTEE ON FLOOD CONTROL

RECOMMENDATIONS made in the report on the relation of forestry to flood control issued by direction of the Committee on Flood Control of the House of Representatives and prepared by the Forest Service of the United States Department of Agriculture are summarized in the New York *Times* as follows:

Completely organized forest-fire protection as the first step in improving forest cover should be rapidly put into effect by the federal government, the states and the landowners.

Cooperative forest planting should be extended, so that idle and waste submarginal lands may be reforested. Results will be of increasing value from a flood standpoint through increased local water retention and decreased run-off and erosion. Planting is important in many of the critical areas, particularly in the bluff region from the Ohio River southward, in southwestern Wisconsin and in the Ohio River drainage. Machinery for carrying out these first two recommendations already is provided in the Clarke-McNary forestry act.

Increase is recommended in forest extension activities to acquaint owners of submarginal or forest lands with the best methods of treating these lands. This calls for increased activity among farm woodland owners under existing authority in the Clarke-McNary act, and for further authority to carry this extension to other than woodland owners.

Continued protection and administration of the national forests, parks and game refuges under present policies is recommended and addition to the national forests of adjoining forested areas of unreserved public domain to insure the protective benefits found in organized federal administration.

Prompt extension of public ownership is recommended in many critical forest areas; first, in order that the federal government may have the direct jurisdiction necessary to enable it to improve forest conditions on lands which now contribute unnecessarily large and destructive run-off, and, second, to enable the federal government to protect heavy investments in flood-control structures, the permanency of which would otherwise be jeopardized by serious erosion. In addition to lands within purchase units already approved the report indicates some 6,000,000

acres in critical areas which should be administered as public forests. For the better management, protection and reforestation of the remaining 125,000,000 acres of forest land in the Mississippi watershed not in public ownership reliance is placed on individual and cooperative effort, stimulated by federal and state cooperation and leadership.

"It remains to be seen," says the report, "how far such a plan will be found adequate to meet the situation. If success exceeds reasonable expectations, it may be possible to reduce somewhat the total area to be finally purchased. On the other hand, if private forestry, even under the stimulation of federal and state assistance, fails in any substantial measure to meet the requirements of satisfactory stream-flow regulation and soil conservation, to that extent its replacement by public forestry is inevitable. The only other alternative would be to classify flood destruction and soil depletion as less troublesome and costly than the cure, an admission of weakness and incompetence too distasteful for the people of this country to accept."

Investigations into the ways and means of arresting erosion by forestry measures, the determination of the best species of plants for revegetating denuded and eroding lands and the conditions under which they should be used, and research into proper management of range, pasture and forest lands, also are recommended. These investigations should be carried on simultaneously at several places in the Mississippi Valley. They are badly needed in the bluff region on the east side of the Mississippi River, in southwestern Wisconsin, in the rolling or plateau lands of the lower Ohio River drainage proper, and in the mountainous section of the Appalachians. They are also badly needed in the Arkansas "Breaks," in the northwestern "bad lands," and at several places in the open range lands.

## THE NEW LABORATORY BUILDING AT COLUMBIA UNIVERSITY

THERE is being erected at Columbia University at a cost of $1,000,000 a new building, which according to Dr. Henry Lee Norris, director of buildings, as reported in the New York *Tribune,* will be one of the finest and best equipped laboratory buildings in the country.

The building is designed primarily to house the department of natural sciences, will be ten stories high and will be equipped with many modern laboratories. On the roof will be an experimental greenhouse for the use of the department of botany. Floor connections with the Schermerhorn building will be made so that the new structure will be in a sense an annex, corresponding to the Chandler laboratories opened two years ago on the opposite side of the campus.

Construction work is being pushed steadily. The framework has been up for several months and the brick walls are almost completed. The greenhouse has been so designed that it will fit in with the general planning level of the Columbia buildings. The new campus addition is situated on the north side of the campus at Amsterdam Avenue and 119th Street.

Zoology, botany, mineralogy, psychology and agriculture departments will be housed in the annex, relieving an overcrowded condition in Schermerhorn Hall that has existed for several years. One floor of classrooms separates the departments, providing expansion when needed. The building design has been made flexible so that in future years classrooms may be turned into laboratories without too much remodeling.

The department of psychology has been without a permanent home for some time, its present headquarters being in the physics building on 120th Street. Removal of these offices to the annex will not only provide better quarters for the psychologists, but will make way for expansion in the physics department.

Columbia's campus is gradually being enlarged according to a well-ordered plan. With all of the gaps filled with structures, both Broadway and Amsterdam Avenue will be lined with solid rows. Entrances to the campus will be made in the cross-streets.

The new annex under construction adds another link to the group which will eventually surround "The Green" at the north end of the campus, the more recent additions being the Chandler laboratories and the physics building.

## SUMMER WORK OF HARVARD GEOLOGISTS

ACCORDING to an article in the *Harvard Alumni Bulletin,* Professor R. A. Daly, Professor Charles Palache and Professor E. S. Larsen will not be in the field, but will stay in or near Cambridge and complete studies begun earlier. Professor Kirtley F. Mather and Professor P. E. Raymond will conduct the Harvard summer field course in geology in the Canadian Rocky Mountains. At the end of July, Professor L. W. Collet, of the University of Geneva, Switzerland, and his assistant, Dr. Edward Parejas, will join them in a detailed study of the structure of the Rocky Mountains in Canada. This will be a Shaler Memorial investigation and will occupy the party the remainder of the summer.

Professor Kirk Bryan will spend the early part of the summer in a study for the U. S. Geological Survey in cooperation with the U. S. Bureau of Reclamation. The work will be on the irrigation projects on the Pecos River in southeastern New Mexico and Texas. Professor Bryan will examine the Avalon Reservoir on the Carlsbad Project, several sites on the Red Bluff

Project further down-river and the El Vado dam site for the Middle Rio Grande Conservancy Districts. The remaining time will be given up to physiographic studies in the basin of the Rio Grande under a grant from the Shaler Memorial Fund.

Professor L. C. Graton plans to enlist the services of his advanced students in his geological work in Canada. Professor D. H. McLaughlin, who will resume his study of the geology of the Homestake Mine in South Dakota, will be assisted by S. C. Davidson, and J. K. Gustafson, Austin teaching fellow in physiography. H. J. Fraser, assistant in geology, will devote the summer to research with Professor Graton on the permeability of rocks to mineralizing solutions. The research is financed by mining interests of Northern Rhodesia, South Africa.

P. A. Schafer, assistant in meteorology and geology, will return to Canada for a second summer of investigations for one of the mineral exploration companies. H. A. Powers, instructor in petrography, who will leave the staff of the division to join the U. S. Geological Survey, has been assigned to map the geology of the island of Hawaii. He will work in conjunction with Dr. T. A. Jaggar, who was at one time a member of the division. Russell Gibson, instructor in economic geology, expects to resume his work in the west with the U. S. Geological Survey. R. T. D. Wickenden, assistant in geology and paleontology, will be an assistant with field parties of the Geological Survey of Canada, working on Cretaceous and Pleistocene deposits of Manitoba.

## COMMITTEES OF THE AMERICAN ENGINEERING COUNCIL

ANNOUNCEMENT of the membership of committees of the American Engineering Council, which will work with Congress and the Federal Administration in shaping public policies involving vast engineering operations, has been made by Arthur W. Berresford, of New York, president of the council. The council was organized in 1919 under the headship of Herbert Hoover.

D. Robert Yarnall, manufacturer of Philadelphia, has been appointed chairman of the Public Affairs Committee. Mr. Yarnall is a representative on the council of the American Society of Mechanical Engineers. Public questions affecting engineers generally will come before this committee, the other members of which are:

J. L. Hamilton, St. Louis.
John Lyle Harrington, Kansas City, Mo.
H. A. Kidder, New York City.
W. S. Lee, Charlotte, N. C.
R. C. Marshall, Jr., Chicago.
R. F. Schuchardt, Philadelphia.
Charles Penrose, Philadelphia.
C. E. Skinner, East Pittsburgh, Pa.
Max Toltz, St. Paul, Minn.
Edwin F. Wendt, Washington, D. C.

A new committee on communications has been named to study proposed legislation for federal supervision of such means of communication as radio, telephone and telegraph. Bills by Senator Watson of Indiana and Senator Couzens of Michigan are now pending which contemplate the establishment of a Federal Communications Commission analogous to the Interstate Commerce Commission, and the Council's Communications Committee, headed by Edwin F. Wendt, will study the fundamental questions raised by the Watson and Couzens bills. Other members of the Communications Committee are:

O. H. Caldwell, New York, federal radio commissioner.
Dean Dexter S. Kimball, Cornell University.
Frank A. Scott, Cleveland.
Charles B. Hawley, Washington, D. C.

Another committee is that on flood control, of which Gardner S. Williams of Ann Arbor, Mich., is chairman. The committees, according to Mr. Berresford, are already at work and at a meeting of the council's administrative board, to be held in Washington in October, will submit reports reflecting the engineering attitude toward legislation arising at the next session of Congress.

Chairmen of other committees of the council were announced as follows:

*Power*—Farley Osgood, New York.
*Reforestation*—William Boss, University of Minnesota.
*Street and Highway Safety*—M. M. Fowler, Chicago.
*Recent Economic Changes*—Dean Dexter S. Kimball, Cornell University.
*Engineering and Allied Technical Professions*—H. C. Morris, Washington, D. C.
*Regional Activities*—O. H. Koch, Dallas, Texas.
*Program of Research*—Dr. Harrison E. Howe, Washington, D. C.
*Man-Hour Information*—L. P. Alford, New York.
*Patents*—Edwin J. Prindle, New York.
*National Hydraulic Laboratory*—Farley Osgood, New York.
*Washington Potomac Canal*—D. H. Sawyer, Washington, D. C.
*Finance*—John H. Finney, Washington, D. C.

# SCIENTIFIC NOTES AND NEWS

AT the meeting of the British Association for the Advancement of Science, now being held in Cape Town, the South Africa Research medal, founded in commemoration of the visit of the association to South Africa in 1905, will be presented to Dr. Robert Broom for his archeological and anthropological researches.

THE degree of doctor of science *honoris causa* was conferred by the University of Leeds on Dr. Charles H. Mayo, of Rochester, Minnesota, on July 23. Dr. William J. Mayo was similarly honored in 1924. The University of Manchester conferred honorary degrees on the Mayo brothers on July 14.

PROFESSOR CHARLES SCHUCHERT, curator emeritus in vertebrate paleontology of the Peabody Museum of Yale University; Dr. E. O. Ulrich, geologist, U. S. Geological Survey, and Dr. Thomas Wayland Vaughan, professor of oceanography and director of the Scripps Institution of Oceanography of the University of California, have been elected foreign members of the Geological Society, London.

DR. CARL KASSNER, professor of meteorology in Berlin, has been elected a corresponding member of the Bulgarian Academy of Sciences.

ALFRED REHDER, curator of the herbarium of the Arnold Arboretum at Harvard University, has been elected a corresponding member of the Peking Society of Natural History, China.

A PORTRAIT of Henry H. Wing, professor emeritus at Cornell University, formerly head of the department of animal husbandry in the State College of Agriculture, was presented to the university on June 15. Dr. Wing, who retired in 1928, was a member of the faculty for more than forty years. The portrait was presented by Mr. Jared W. Stiles, '29, in behalf of former students of Professor Wing and his faculty associates, and was accepted by President Farrand. Dean Albert R. Mann, '04, of the College of Agriculture, spoke on Professor Wing's career. The portrait was painted by Professor Olaf M. Brauner.

DR. OTTO WARBURG, professor of botany at Berlin, celebrated his seventieth birthday on July 20.

PROFESSOR CLIFFORD C. CRUMP, professor of astronomy and director of the Perkins Observatory at the Ohio Wesleyan University, has been appointed professor of astronomy and director of the observatory at the University of Minnesota.

DR. ROLAND BROWN, of the department of geology of Yale University, recently appointed as paleobotanist in the U. S. Geological Survey, has taken up his work in Washington with offices in the section of paleobotany of the National Museum. Dr. Brown's first work will embrace field and office studies of the Fort Union floras.

DR. ARTHUR W. GRAY has joined the staff of the Brown Instrument Company as associate director of research. He will be engaged mainly in the development of scientific and industrial instruments. During the past thirteen years, Dr. Gray, formerly of the Bureau of Standards, has served as director of physical research of the L. D. Caulk Company, as physicist for the Calco Chemical Company, and as vice-president and director of research of Dielectric Products, Inc.

DR. ROBERT K. NABOURS, of the department of zoology of the Kansas State Agricultural College, will be on sabbatical leave for the year beginning on September 1, which he will spend as research associate in the department of genetics of the Carnegie Institution of Washington, at Cold Spring Harbor, Long Island, aided by grants from the institution and from the National Academy of Sciences. During his absence Dr. J. E. Ackert will be acting head of the department.

DR. CARL L. ALSBERG, director of the food research institute at Stanford University, has been appointed a member of the United States delegation to the Conference of the Institute of Pacific Relations which will meet in Kyoto, Japan, from October 28 to November 9.

MR. J. WALTER DRAKE, a director of the National Automobile Chamber of Commerce and former assistant secretary of commerce, has been named chairman of the United States delegation to the second Pan-American Highway Conference which convenes at Rio de Janeiro on August 16. The delegates include Thomas H. MacDonald, chief of the bureau of public roads; Frank T. Sheets, chief highway engineer of Illinois, and Charles M. Babcock, commissioner of highways of the State of Minnesota.

PROFESSOR WILLIAM E. HOFFMANN, of Lingnan University, Canton, China, attended the fourth Pan-Pacific Science Congress in Java, which was held from May 16 to 25, at which he represented the university, the Peking Society of Natural History, the American Association of Economic Entomologists and the Entomological Society of America.

Three of its research specialists will represent the U. S. Forest Service at the International Congress of Forest Experiment Stations to be held this month at Stockholm, Sweden. They are: E. N. Munns, in charge of the Office of Forest Experiment Stations, Washington, D. C.; Dr. Joseph Kittredge, Jr., of the Lake States Forest Experiment Station, St. Paul, and Dr. A. J. Stamm, of the Forest Products Laboratory, Madison. Between 150 and 200 foresters engaged in forest research are expected to attend the Stockholm meeting—the first international congress held since 1910. Following the meeting the Forest Service officers will make a study of forest research in Sweden and several other European countries in which forestry technique has been highly developed

and forest products are being grown successfully on a continuous crop basis.

A COMMITTEE of the U. S. Department of Agriculture, consisting of Dr. B. Youngblood, principal economist of the Office of Experiment Stations (*chairman*); Dr. Karl F. Kellerman, associate chief of the Bureau of Plant Industry, and H. R. Tolley, assistant chief of the Bureau of Agricultural Economics, has been appointed to survey the state agricultural work in North Carolina and make suggestions for development. The work is being carried on by the state college of agriculture, the state agricultural experiment station, the state extension service and the state department of agriculture. The committee spent some time in North Carolina recently making a preliminary study of the work of the several state agencies.

DR. J. W. GIDLEY, of the U. S. National Museum, is visiting several localities in Idaho, one in Montana, one in Oregon and probably one in Washington, for the purpose of examining reported finds of fossil bones. This work being completed, he will visit the museums at the University of California, Los Angeles, Pasadena, Denver and Kansas.

DR. WILLIAM J. KERR, professor of medicine at the medical school at the University of California, has returned to San Francisco after nine months spent in research in England with Sir Thomas Lewis, heart specialist.

DR. RESIK BEY, minister of health of Turkey, and Dr. Assim Bey, chief medical officer of the ministry of health of Turkey, are visiting the United States.

MRS. DELIA J. AKELEY, the explorer, who led the Brooklyn Museum Expedition into Central Africa, recently described her experience in an illustrated lecture in the McMillin Academic Theater at Columbia University.

DURING the latter half of June, Dr. Henry C. Sherman, Mitchill professor of chemistry at Columbia University, lectured on the chemistry of nutrition in the summer session of the Colorado Agricultural College; and on June 24 he addressed a joint meeting of the college assembly, the local Sigma Xi Club and visitors from several chapters of the society upon "Science in the Service of Health and Longevity."

*Industrial and Engineering Chemistry* reports that Albert Sauveur, Gordon McKay professor of metallurgy and metallography in Harvard University, has accepted the invitation of the board of directors of the American Society for Steel Testing, to present the E. D. Campbell Memorial Lecture for 1929. This lecture was established by the directors of the society in 1926 to perpetuate the memory of its honorary member, Edward DeMille Campbell, of the University of Michigan. The first lecture was presented by Dr. Guertler, of Germany; the second by Zay Jeffries, of Cleveland; the third by W. H. Hatfield, of England. Dr. Sauveur's lecture will be given on Wednesday morning during the National Metal Congress and Exposition to be held in Cleveland the week of September 9.

A MEMORIAL to Hudson Maxim, inventor, was dedicated at Lake Hopatcong on July 13. The memorial, a ten-ton boulder on which there is a bronze tablet, was unveiled by Doris Maxim, a granddaughter. Dr. Miller Reese Hutchinson, member of the U. S. Naval Consulting Board, was master of ceremonies. Dr. Spencer Miller, Dr. Henry B. Kummel and Charles G. Muller made addresses.

THE Philadelphia County Medical Society is making arrangements for the painting of a large portrait of Pasteur which will be installed in its headquarters office at a date to be announced.

THE centenary of the birth of the physiologist Eduard Friedrich Wilhelm Pflüger, the founder of *Pflüger's Archiv*, who died in 1910, was celebrated on June 7 at Bonn, where he was professor for fifty years.

THE Pacific Science Congress voted at the recent fourth triennial meeting in Java to hold its next meeting in Canada in 1932. The first meeting was held at Honolulu, Hawaii, the second in Australia and the third in Tokyo.

*The Collecting Net* reports that the General Education Board has given $200,000 to be added to the endowment fund for the general purposes of the library of the Marine Biological Laboratory at Woods Hole, Massachusetts. This with the original endowment will bring the income of the library up to about $25,000 a year. In 1925 the board appropriated $50,000 for the library which has been expended on the purchase of books and monographs.

THE New York Academy of Sciences announces three prizes offered by Mr. A. Cressy Morrison, to be known as the A. Cressy Morrison Prizes I, II and III. Prize I, of $750, will be awarded in December, 1930, for the best paper on solar and stellar energy. In December, 1929, Prize II will be awarded for the best paper on experimental biology and Prize III for the best paper on a scientific subject not covered by the first two prizes. The competition for Prize I is open to all. Prizes II and III are limited to members of the academy and affiliated societies, but non-members may become eligible by joining one of these organizations before the closing date.

A COLLECTION from various parts of British New Guinea, visited by airplane, has been presented to the U. S. National Museum by Dr. E. W. Brandes. Dr.

Brandes flew over 10,000 miles in mostly unknown territory.

A SLAB of sandstone containing the bones of extinct mammals of the Miocene Period from an agate quarry in Nebraska has recently been acquired by the museum of Wesleyan University. The giant matrix was purchased from Mr. J. D. Figgins, formerly curator of the Colorado Museum of Natural History at Denver. The slab is unique in the abundance of bones and in having in one slab three forms from one locality.

*The Geographical Journal*, London, has received details about a proposed expedition to Greenland, under Professor A. Wegener, the expenses of which are to be defrayed by the German government through the Notgemeinschaft der Deutschen Wissenschaft. Professor Wegener, who before coming prominently before the public as the author of the theory of continental drift had taken part in the exploration of the inland ice of Greenland, arrived in Copenhagen in February to make arrangements for a preliminary expedition this year in preparation for the main undertaking planned for 1930, the object of which is the detailed study of the ice-sheet. For this purpose three stations will be established in the same latitude, but at wide intervals. The first will be at Perdlorfik in the Umanak district in West Greenland, about 20 km within the border of the ice. The second will be dug into the central part of the ice-sheet, and three or four men will winter there. The third will be on Scoresby Sound in East Greenland. By this means the temperature of the ice in its different strata will be investigated. The expedition will be provided with all modern appliances, including, in addition to dog sledges, motor sledges with air propellers, and Icelandic ponies will be used for forming the depots on the ice. Radio and weather-forecasting stations will be established at the various stations.

WE learn from *The Experiment Station Record* that the Agricultural and Veterinary College of Minas Geraes, Brazil, held its first commencement on December 15, 1928, granting certificates to two students from the one-year course. The total enrolment of the college in all courses is seventy. At the close of the year the State of Minas Geraes established a new position of technical adviser in agriculture, to which Dr. P. H. Rolfs, head of the college for the past eight years, has been appointed. Dr. Rolfs is to continue his residence at the college, but will have general supervision of all agricultural activities of the state government. Dr. Bello Lisbôa, chief engineer for six years in charge of the construction work of the college and for two years vice-director, has succeeded Dr. Rolfs as director. The State of Minas Geraes is greatly enlarging its agricultural activities in other directions. A bureau, principally for the protection of livestock against diseases, has been established at Bello Horizonte with Dr. Hermann Rehaag as chief, and the state is preparing to organize a citrus station of 40,000 trees and conduct a modern exporting plant for citrus fruit. A biological institute corresponding to an experiment station is also to be established at the college with the principal members of the staff recruited from abroad.

IT is reported in *Nature* that the John Melrose Laboratory of the Waite Institute for Agricultural Research in South Australia was officially opened in April. The laboratory has been built with the aid of a gift of $50,000 from Sir John Melrose. The institute was established some years ago as the result of a gift by the late Mr. Peter Waite to the University of Adelaide for the purpose of furthering education and research in agriculture and allied subjects. The endowment comprises the Urrbrae, Claremont and Netherby estates lying on the scarp of the Adelaide foothills within four miles of the city and consisting of nearly 300 acres. In addition there is a trust fund of £58,450. Of recent years considerable assistance has been forthcoming from the state government, the Empire Marketing Board, the Council for Scientific and Industrial Research, the Imperial Chemical Industries, Ltd., and the Commonwealth Bank of Australia. It is understood that the Council for Scientific and Industrial Research and the University of Adelaide are discussing a project for establishing jointly at the institute a division of soils research.

*The Christian Science Monitor* reports that the College of Engineering, Copenhagen, which is at present engaged in constructing extensions almost tripling its actual capacity, is to celebrate its centenary at the end of August by holding a congress of Scandinavian engineers. About 1,000 visitors are expected to attend and the congress consists of eighty honorary presidents, all distinguished engineers, with a special board, comprising a leading engineer from each of the Scandinavian countries—Denmark, Sweden, Norway, Finland and Iceland—assisted by an organizing committee of rather more than a score of engineers. The opening takes place on August 28, in the large hall of the Industrial Society, the first address being given by Professor P. O. Pedersen, the director of the Copenhagen College of Engineering, on "Development of the Electrical Technique of Communication and Denmark's Contributions in This Field." The actual centenary jubilee will be solemnized on August 30, commencing with an impressive function in the Forum. A special "Cantata" has been written by the poet, L. C. Nielsen, for which Carl Nielsen has composed the music. The King of Denmark will be present. On the last day of the congress the members

will be taken to Elsinore by the East Asiatic Company's motor vessel *Fiona* where the congress will be formally brought to its conclusion in the Knight's Hall of the ancient Kronberg Castle.

THE first step in giving effect to the recommendations of the Indian Royal Commission on Agriculture, according to *The Christian Science Monitor,* has been taken by the government of India, which will shortly set up an Imperial Council of Agricultural Research. The commission recommended that the council should be an independent body to promote, guide and coordinate agricultural and veterinary research throughout India. The government, however, modified this proposal considerably, the alterations tending to bring the council more under governmental control. It is not desirable that the Legislative Assembly should be deprived of its normal constitutional control over an activity which affects the staple industry of the country. The central organization is to have an executive body and an advisory board. The member of the viceroy's executive council in charge of agriculture will be chairman of the board, which will include the principal administrative officer of the council and representatives of the Central Legislature, the Provincial Governments and other bodies. The chief administrative officer will serve also as chairman of the advisory board, which will consist largely of experts and its duties will be to examine all proposals in connection with the scientific objects of the council.

AT the meeting of the Highway Research Board of the National Research Council in Washington, on December 13, R. W. Crum, director, announced that arrangements had been made for conducting an investigation of methods of curing concrete pavement slabs. The work will consist first in making a correlation survey of all available existing data. These data will be analyzed and submitted to a special committee appointed by the board. The further program of the project will depend upon the findings of this committee.

A NATIONAL experimental station, under the auspices of the University of Washington, is planned, designed to aid the Northwest in such problems as reclamation, flood control, hydro-electric development and industrial expansion. The rivers and harbors bill to be enacted by the national congress at its next session authorizes the secretary of war and chief of engineers to establish several such laboratories for determination of fundamental data useful in hydraulic engineering. According to Professor Charles Harris, in charge of the university laboratory, among the problems waiting solution include river and harbor improvement, water measuring devices in connection with seepage problems, methods of bank and pier protection and the study of dams and spillways by means of models. The board of trustees of the Seattle Chamber of Commerce have passed a resolution stating the mutual advantage to the state of Washington, the University of Washington and the federal government to have one of the national hydraulic laboratories established on the Seattle campus, and have directed their Washington, D. C., bureau to assist in obtaining the laboratory.

A FOREST PROTECTION BOARD has been inaugurated by the U. S. Department of Agriculture in order further to aid in the development of general policies for the protection of the forests of the United States and in the preparation of coordinated plans therefor, the informal committee set up by the chief coordinator under date of May 28, 1928, is hereby established as a coordinating agency to be known as the forest protection board. The board will be constituted as follows: The chief of the Forest Service, Department of Agriculture, chairman *ex officio;* the chief of the Weather Bureau, Department of Agriculture; the director of the National Park Service, Department of the Interior; the commissioner of Indian Affairs, Department of the Interior; the commissioner of the General Land Office, Department of the Interior; the chief of the Bureau of Biological Survey, Department of Agriculture; the principal entomologist in charge of forest-insect investigations, Bureau of Entomology, Department of Agriculture, and the principal pathologist in charge of the office of forest pathology, Bureau of Plant Industry, Department of Agriculture. The forest protection board shall, subject to the approval of the chief coordinator and within the limitations of existing law, coordinate the policies and plans for the prevention and suppression of forest fires and for general forest protection formulated by the several federal bureaus and agencies charged with the protection of the forests of the country.

## UNIVERSITY AND EDUCATIONAL NOTES

SPACE for the division of plant nutrition is being provided at the University of California in the new life science building now under construction at a cost of approximately $1,750,000. An extensive poultry plant has recently been built and equipped at a cost of $80,000.

SIX new buildings, approximating a total expenditure of two and a half million dollars, will be constructed on the campus of the Pennsylvania State College within the next two years, according to plans approved by the board of trustees of the college. Funds for the program come from the $2,250,000

state appropriation and from the emergency building fund raised several years ago by alumni and friends of the college.

THE following changes have been made in the department of chemistry at the University of Chicago. Dr. Thorfin Rusten Hogness, associate professor of physical chemistry at the University of California, has accepted an appointment as associate professor of physical chemistry. He will begin his work on January 1, 1930. Dr. William A. Noyes, Jr., assistant professor of chemistry, has resigned to accept an appointment as associate professor of physical chemistry at Brown University. His resignation will take effect on October 1. Dr. Preston Mayne Harris has been appointed instructor in chemistry. Dr. Harris is a Ph.D. of the Ohio State University and has spent the past year as National Research Fellow with Professor Arthur Compton at the University of Chicago. Dr. David M. Gans has been appointed instructor in physical chemical research, cooperating with Professor Harkins. Dr. Gans is a Ph.D. of the University of Chicago, 1929. The department of chemistry will occupy in September the George Herbert Jones Laboratory for research and graduate work in chemistry.

H. V. MOYER, PH.D. (University of Kansas), National Research Council Fellow at Yale University, and H. L. Johnston, Ph.D. (University of California), assistant in the department of chemistry at the University of California, have been elected to assistant professorships of chemistry at the Ohio State University. M. L. Wolfrom, Ph.D. (Northwestern University), National Research Council Fellow at the university, has been appointed instructor.

DR. F. W. LOOMIS, of the department of physics of New York University, has been appointed head of the department of physics in the University of Illinois.

THE University of Virginia announces the establishment of a chair of public health and hygiene and the appointment of Dr. Kenneth F. Maxcy, of the U. S. Public Health Service, as the first incumbent. Dr. Maxcy graduated at the Johns Hopkins University School of Medicine in 1915 and received the degree of doctor of public health at the Johns Hopkins in 1921.

MR. JAMES HOLMES, lecturer in geography at Armstrong College, Newcastle-on-Tyne, has been appointed professor of geography at the University of Sydney, in succession to Dr. Griffith Taylor, who recently joined the faculty of the University of Chicago.

DR. CLARENCE J. CAMPBELL, formerly professor of physiology at Syracuse University, has been appointed professor of pharmacology at Dartmouth College.

# DISCUSSION

## PRIORITY IN STRATIGRAPHIC NOMENCLATURE

PRIORITY is a fundamental principle in all types of scientific nomenclature, and it is equally as necessary as it is fundamental. Scientific units, whether they be animals or plants or minerals or chemicals or fossils, need specifically to be named, and, to be of value, this name must have universal adoption, must be in accord with other names for like units and must not be subject to unnecessary change. Professional ethics, if nothing else, has suggested that the first name properly applied to a scientific unit be adopted by other authors, in recognition of the work of the first designator as well as for convenience of description. Since it is not always possible to search out the original term or to understand its exact application, the first name is often undiscovered or unusable, and later names are accepted. This practice of recognizing the first name given to a unit—with the proviso that name and unit can be unmistakably associated—has been dignified in zoological nomenclature into the law of priority (Article 25, International Rules of Zoological Nomenclature).

In stratigraphic geology, to certain rock formations or sedimentary units are given definite names by which they may become known to other workers in geology. In most cases, these names are of geographic derivation, and are taken from the name of that place where the particular rock series is best exposed. Thus we may have the Shady dolomite, named from Shady Valley in Tennessee. But if this same series and sequence of rocks has in nearby regions been also called the Sherwood, Tomstown, Beaver or Aldrich limestone, by what principle should we choose the proper name to use? Since stratigraphers and geologists are more or less familiar with the rules of zoologic nomenclature, it has come to be largely accepted that the law of priority of designation should be applied in the naming of these sedimentary units in much the same way as this law is applied in the naming of fossil forms. In other words, that whatever name was first properly applied to a rock formation should be retained, while any later terms should be put into synonymy and abandoned.

Any system of scientific nomenclature is an artificial and arbitrary scheme, created largely for the

proper purpose of preventing or eradicating error and confusion in scientific discussion. That is to say, to make sure that what is referred to under a certain name by one man will be known to all others in that field by the same name. Not always, however, is precision profoundly served by rigid adherence to the rules of any system of nomenclature. Even the carefully planned International Rules of Zoological Nomenclature may cause inconvenience if not confusion if too strictly applied in every instance. As a possible example of this, consider the case of Nummulites, one of the most widely known fossils and invertebrates. It is not necessarily certain that convenience will be served and confusion avoided if the name of this form be changed to Camerina, on the ground that Brugnière in 1792 and not Lamarck in 1801 gave the first name to the fossil foraminifer. Similar instances arise from a strict application of the law of priority to stratigraphic names. The writer was recently interested in the nomenclature of a certain formation in the Appalachian Valley to which in good faith but at different outcrops eight separate names had been applied by seven workers, and the first name to be applied was the least used of the lot. Of the eight names given to this unit, obviously seven should be discarded, but why abandon the one most widely used in preference to the one least known?

For some time, the writer has been opposed to the practice of rigidly applying priority of designation in stratigraphic nomenclature, and he has been recently gratified to find that the U. S. Geological Survey is similarly opposed to too strict an application of this principle. The writer would like to propose what he would call the law of priority of adopted usage which, together with the established law of priority of designation, would apply to the determination of the proper names for stratigraphic units.

In other words, when (as in the case of the Shady dolomite) it is necessary to choose from a number of names applied to a rock formation one which is to serve as the future corrected name, the first term properly applied should be retained and the others discarded, *unless* by so doing that name which has gained the widest currency in geologic literature will thereby be abandoned in preference to an obscure term. In that case, let priority of designation be waived in favor of priority of adopted usage, lest confusion rather than precision be gained. The application of this proposal is neither strikingly new nor novel in current geologic practice, and it is hoped that it will be more widely adopted. Its application in zoologic nomenclature is worthy of consideration.

HERBERT P. WOODWARD
NEW JERSEY LAW SCHOOL
MARCH 5, 1929

## DID JOHN NAPIER INVENT LOGARITHMS?

IN 1904 H. Poincaré published a letter under the heading "La Terre Tourne-t-elle?" in which he explained a point of view according to which the rotation of the earth can not be regarded as an established fact, but he emphasized at the same time the desirability of assuming that the earth does rotate, since this assumption is a fundamental harmonizing factor in our scientific thinking. Similarly, the heading of the present note aims merely to emphasize a point of view according to which one might be inclined to say that John Napier did not invent our common logarithms, since the nature of Napier's contributions becomes much clearer if it is viewed also from this standpoint.

The term logarithm itself, which Napier applied to his tables, points to a wide difference between the use he had in mind and our present common view of the main use to be made of logarithmic tables. The term logarithm means ratio number, and Napier's tables were invented with a view to their usefulness in working with ratios, especially with the equality of ratios, or proportions. Hence the fundamental laws that the logarithm of the product is equal to the sum of the logarithms of the factors and that the logarithm of 1 is 0 do not apply to his tables. These facts suffice to exhibit a very wide difference between his tables and our modern logarithmic tables and they seem to justify the heading noted above.

It is true that Napier expressed some views relating to logarithms which were not embodied in his tables, but these tables are commonly called the earliest logarithmic tables and the claim that Napier is the inventor of logarithms has been largely based thereon since the theory of logarithmic computation was developed by earlier writers, especially by N. Chuquet and M. Stifel. In fact, traces of this computation are found in Euclid's "Elements," and more explicitly in the work of Archimedes. If we regard the terms of the arithmetic series which Archimedes associated with a geometric series as the logarithms of the corresponding terms of the latter series it results that the logarithm of the product of two factors is equal to the sum of the logarithms of these factors diminished by the logarithm of 1, which is not 0, just as in Napier's tables.

It is, however, not our main object to prove here that the question noted in the heading should be answered in the negative, but to direct attention to another clear illustration of the general principle that many scientific questions which are commonly answered in the affirmative may be greatly clarified by considering also the negative thereof. Historical questions seem to be especially adapted to be presented in the form of disputations since the negative side of commonly accepted views is more likely to

become clear when presented in this manner. Sometimes book reviews aim to throw additional light on questions considered by their authors by referring to views which would naturally lead to conclusions which do not agree with those expressed by these authors. From the standpoint of scientific progress such efforts do not seem to deserve condemnation.

G. A. MILLER

UNIVERSITY OF ILLINOIS

## DINOSAUR TENDONS

WHILE engaged on an interpretation of certain lesions in the Pleistocene Sabre-tooth,[1] an examination was made of the histological structure of ossified tendons in two genera of dinosaurs. The material thus at hand was deemed worthy of closer description and illustration, and the account was published.[3] An unexpected result developing from such a study was the distinction of histological structure in the two genera: *Trachodon* and *Ankylosaurus*. Although Broili[3] had previously investigated the nature of the tendons in one of these genera and Weidenreich[4] has dealt with genetic and developmental factors, yet it seems not to have been previously noted that there are generic differences in the histological structure of the ossified tendons. In order to test that distinction it will be necessary to study many more tendons of several genera and families of dinosaurs in which such objects are preserved. If generic and family differences can be detected in the ossified tendons it will go far in establishing these groups as of long standing and based on fundamental features.

Dollo[5] and Brown[6] have discussed the occurrence, distribution and function of the ossified tendons among the various genera of dinosaurs in which they occur, but this phase of the subject needs revision.

An early paper by Lieberkühn[7] is of importance as dealing with the histological changes involved in the transformation of tendons into bone.

Seitz[8] has written the most ambitious account of the histology of fossil bone which has yet appeared, having studied sections of bone from the Permian, Triassic, Jurassic and Cretaceous reptiles, as well as three genera of Tertiary reptiles and four Recent genera. Seitz had in mind a contribution to ancient histology and made no attempt to determine generic or family distinctions in the histological features of bone, nor did he study any ossified tendons, so far as I can determine.

Broili[3] made an interesting beginning by comparing the histology of ossified tendons of *Trachodon* with a transverse section of the neural spine of one of the sacral vertebrae of the same species. Other comparisons should be made. I am sure Broili is mistaken in regarding the ossified tendons as "verknöcherte Muskeln," for ossification does not involve the sarcous portion of the muscle, but only its connective tissue sheaths. Similarly, many paleontologists confuse *tendons* and *ligaments*, which anatomically have different origins, different structure and different functions.

ROY L. MOODIE

SANTA MONICA, CALIFORNIA,
MAY 28, 1929

## LACTATION VS. IMPROVED GROWTH IN STOCK ALBINO RATS[1]

A RECENT report from this laboratory[2] described unusually rapid growth in the stock colony of rats. The animals whose records provided the data for the study were born, for the most part, in the late summer and early fall of 1927. The ration consisted of a mixture of whole ground wheat two thirds, dried whole milk one third, calcium carbonate and sodium chloride each 1 per cent. of the weight of the wheat. Fresh lettuce was given daily and the lactating females received in addition nine grams of tested dried yeast per week. The dry ration is based on the Diet B of Sherman but differs in the smaller amount of sodium chloride and in the addition of calcium carbonate.

Beginning in the early fall of 1928 difficulty of reproduction was encountered in this colony. Litters

[1] "Studies in Paleopathology," XX. "Vertebral Lesions in the Sabre-tooth, Pleistocene of California, Resembling the So-called Myositis ossificans progressiva, Compared with certain Ossifications in the Dinosaurs," *Annals of Medical History*, IX, no. 1, 91–102, 11 figs.

[2] "The Histological Nature of Ossified Tendons Found in Dinosaurs." American Museum Novitates, No. 312, 1928.

[3] F. Broili, 1922, "Ueber den feineren Bau der verknöcherten Sehnen (verknöcherten Muskeln) von Trachodon," *Anat. Anz.*, 55: 465. 5 figs.

[4] Franz Weidenreich, 1926, "Wie kommen funktionelle Anpassungen der Aussenformen des Knochenskeletts zustande?" *Paleontolog. Ztschrft.* 8: 34–44; 1923, "Ueber Sehnenverknöckerungen und Faktoren der Knochenbildung," *Ztschrft. f. Anat. u. Entwicklungs*, 69: 558.

[5] L. Dollo, 1886, "Note sur les ligaments ossifiés des Dinosauriens de Bernissart." *Archives de Biologie*, 7: 249–264, pls. 8–9.

[6] Barnum Brown, 1916, "Corythosaurus casuarius: Skeleton, Musculature and Epidermis." Bull. Amer. Mus. Natl. Hist. 35: 709–716, pls. xiii–xxii; 1917, "A Complete Skeleton of the Horned Dinosaur Monoclonius, and Description of a Second Skeleton Showing Skin Impressions," *ibid.*, 37: 281–306, pls. xi–xix.

[7] N. Lieberkühn, 1860, "Ueber die Ossifikation. 1. Die Ossifikation des Sehnengewebes," *Archiv. f. Anat. u. Physiol.*, 838.

[8] Adolf Leo Ludwig Seitz, 1907, "Vergleichende Studien über den mikroskopischen Knochenbau fossiler und rezenter Reptilien und dessen Bedeutung für Wachstum und Umbildung des Knochengewebes im allgemeinen," Nova Acta Abh. der Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher, Bd. LXXXVII, nr. 2, 235–370, with 14 plates (quarto).

[1] From the Laboratory of Physiological Chemistry, Yale University, New Haven, Conn.

[2] A. H. Smith and F. C. Bing: *Jour. Nutrition*, 1, 179, 1928.

of the usual numbers of individuals of normal size were born, but the young either starved to death or were killed by the mother. The difficulty was not characteristic of vitamin E deficiency but seemed attributable to lack of milk production by the mothers. It is striking that the females manifesting this apparent failure in lactation were almost all of the fifth generation on the stock diet. Cod-liver oil given in addition to the ration did not have a noticeably beneficial effect. On the other hand, when the above ration is used after weaning there results the same rapid growth already described.

The present communication does not invalidate the data of the previous publication but does call attention again to the differences in the nutritional demands for growth and for lactation. Moreover, in view of the wide use of the whole wheat-whole milk powder ration in its various modifications, our observations may be significant in calling attention to possible cumulative deficiencies in such restricted food mixtures for reproduction and lactation.

ARTHUR H. SMITH
WILLIAM E. ANDERSON

YALE UNIVERSITY

# SPECIAL CORRESPONDENCE

## STANFORD UNIVERSITY SCIENTIFIC EXPEDITION

A SCIENTIFIC expedition in the interest of the geological sciences from Stanford University into the regions of Lower California and Sonora, Mexico, was made possible through the generosity of Mr. W. L. Valentine, member of the national board of the university. President Ray Lyman Wilbur officially sanctioned the expedition and actively supported its plans. The cooperation of both the United States and Mexican governments was obtained. All arrangements were made and permits secured through the proper official channels.

The party, composed of W. W. Valentine, E. R. Valentine, D. F. Hamelin and L. Wm. Wiedey, all of the Stanford University department of geology, left Los Angeles harbor in January aboard the yacht *Volador*, prepared to carry on for three months field exploration, shore collecting, dredging and bottom sampling. The itinerary scheduled visits at all places along the Pacific and Gulf of California shores of Lower California where favorable anchorages were obtainable. This plan was to be followed throughout, in so far as time permitted. Captain Putta, master of the schooner, possessed a fund of information about the entire region that was a constant source of aid during the progress of the exploration.

The expedition visited most of the large bays and many of the more interesting islands on the Pacific side of the peninsula. The gulf shores, previously having been little visited or explored in this manner, received greater study and attention. After reaching gulf waters and after frequent stops at some of the islands, the party sailed for Guaymas, Sonora, for supplies. Several localities adjacent to that seaport were visited before again crossing the gulf to La Paz. From this most beautiful Mexican village reconnaissance work was carried northward to San Marcos Island. Another trip to the Sonora coast and the seaport of Guaymas was necessary. From that point the expedition returned to the peninsula shore of the gulf at Santa Rosalia. It had been planned on the northward survey to return to the most interesting localities encountered, so frequent stops were made southward from that port. As had been the procedure throughout, runs from one locality to another were made during the night to have the maximum of daylight ashore. Upon reaching the Pacific side once more, fair weather lasted for only a short period and was followed by very severe northwest winds. After anchoring at Cedros Island local, heavy, but intermittent, rains fell about the base of the high peak at the southern end of the island. Few stops were permissible on the return to Los Angeles because of persisting strong winds. The last of March brought to a close much fruitful exploration.

During the expedition many formations were observed. Sediments little metamorphosed of pre-Cretaceous age were developed in a great thickness on Cedros Island. The Cretaceous strata near Ensenada, at Santa Catarina Landing, and on Cedros Island were in each case studied. The Eocene beds were accessible only at Santa Catarina Landing. Oligocene sediments were not recognized at any point. Miocene strata, very similar to those of southern California, are exposed in the vicinity of Turtle Bay and on Cedros Island. A shale facies suggestive of the so-called "Monterey shale" of California is found at both places. The Pliocene marine strata are everywhere abundant, notably on Cedros Island, at Turtle Bay, on Carmen Island, at Pulpit Point, at Conception Bay, on San Marcos Island (near Santa Rosalia) and at Santa Rosalia. In every case fossils were quite common. However, thicknesses of these Pliocene sediments seldom exceeded several hundred feet, in contrast to the many thousands of feet of such strata in southern California. Pleistocene faunas were secured at San Quentin Bay, at Rosarita Bay, at Magdalena Bay, at Pulpit Point and at Conception Bay. It may be explained that marine strata were the first object of our search. As a consequence, efforts were concentrated upon them.

Many localities display the effects of varied igneous phenomena, such as the volcanic cones at Entrada Point, San Quentin Bay; enormous thicknesses of lava in the vicinity of Carmen and San José islands on the east side of the peninsula; an enigmatical mass of finely crystalline lava and volcanic glass composing the mass forming Pulpit Point; hot spring phenomena and lavas, with associated rocks, at San Carlos Bay, Sonora; tuffs, lavas and the like at Santa Rosalia. In addition, a wonderful variety of geological processes is seen to have worked elsewhere. The copper mines at Santa Rosalia, the gypsum deposits of San Marcos Island and the salt deposits of Carmen and San José islands were briefly studied.

The very steep shore-lines along most of the peninsula have been the subject of much comment. Some hold that the peninsula as a whole is a sinking unit, but there appear to be areas that have relatively risen. Contrary to the opinion of a few, it is believed that sufficient evidence exists to show the Pliocene strata not to have been contemporaneously deposited in many places. These observations may indicate that the peninsula has not acted tectonically as a single unit.

Represented among the material collected is apparently the first Pleistocene fauna from the entire Gulf of California region. Both the Pliocene and Pleistocene faunas collected have unprecedented richness in individuals and species and in perfection of preservation. These faunas have previously been very little known and may now be very fully known. Many new localities and their faunas are to be added to those already known from strata of various ages in this region. Species previously known only from Recent shells may now be reported as also occurring in the fossil state. Species new to science likewise are present. Variations among certain forms, temperature changes, relationships to other faunas and the like may be discerned. The marked tropical affinities of the faunas add to their interest. Besides new forms among the Recent shells collected, the ranges of a number of those previously described are to be extended. Correlations with California strata eventually may be more effectively suggested. Results of the nature above mentioned are now being traced. As work progresses these results will appear from time to time under the authorship of the writers of this account, or of others associated with them. The collections have been presented in their entirety to the department of geology, Stanford University, and are to be found there.

LIONEL WILLIAM WIEDEY
WILLIAM W. VALENTINE

STANFORD UNIVERSITY

# SCIENTIFIC BOOKS

*Geologie von Peru.* By G. STEINMANN. 448 pp., 271 text figures, 9 plates and map. Carl Winters, Heidelberg, 1929.

THOSE who are interested in Andean geology have been looking forward for a long while to Steinmann's account of the geology of Peru. This may be regarded as the summation of his personal observations in South America, and of many years of study of collections by himself and his students, with the collaboration of Peruvian friends, especially Dr. Carlos I. Lisson, of Lima.

In the present work the map is credited to the latter, R. Stappenbeck contributes the account of the economic deposits and F. Sieberg the chapter on earthquakes.

The general plan is four pages of physiography forming Part 1; Part 2, comprising 278 pages devoted to the geological succession from pre-Cambrian to Quaternary; Part 3, of twenty-three pages devoted to geological history; Part 4, of sixteen pages devoted to the structure of the Andes; Part 5, of seventy-five pages devoted to economic geology; Part 6, of thirteen pages devoted to earthquakes.

To the pre-Cambrian are referred the gneisses, schists and granites as representing the Archean, although in most cases there is little satisfactory evidence of their age, and a second and supposed later series is termed the Phyllite formation and the suggestion is made that it may represent the Algonkian. This follows the traditional practice of geologists everywhere, but since similar rocks farther south in the Andes are both Mesozoic and Tertiary little credence can be given to these age determinations. For example, the Cerros de Amotape and Silla de Paita are mapped as Archean and the Cerro Illescas as Algonkian, and in all three cases the geological evidence is not more definite than that they are Carboniferous or older.

No Cambrian is known except east of the Andes. The so-called Silurian is Ordovician. Only lower Devonian has been recognized in Peru and this occurs near Huanuco and from Sicuani southeastward. Marine Carboniferous is found from the Amotapes to the Bolivian frontier. Continental Carboniferous on Paracas Peninsula, near Paita, in the Cerro de Pasco region, and near Abancai, is regarded as Lower Carboniferous (Mississippian), although much the most extensive collections known were made by the present reviewer, who regards their age as Upper Carboniferous (Pennsylvanian). No Permian is recognized.

At two or three localities supposed continental Trias is reported, and in the Cerro de Pasco region marine Trias is reported. The evidence upon which this last determination is based is very inconclusive and the absence of recognizable marine Triassic is of general interest, since the Andes is the only great mountain system where these rocks have not been found. The Jurassic is much less fully represented in the Peruvian Andes than farther south and Steinmann recognizes only the Lias, lower Oolite and upper Malm.

The Cretaceous is extensively developed and all the European stages are recognized, although the evidence on which this is based is often far from conclusive. As an example the Barremian stage may be cited. This is credited as wide-spread in Peru on the basis of a few very inconclusively determined fossils. Although cited from the Cordillera Blanca the Ellsworth expedition to that region found no Barremian, and it is certainly singular that what Steinmann calls Barremian in Peru should fail to show any resemblance to the highly characteristic Barremian fauna found in Colombia but should be comparable with certain European species.

Most of the Mesozoic fossils found in the Peruvian Andes are preserved as relatively poor casts and with the exception of some of the ammonites and echinoids have very little value for purposes of intercontinental correlation. Many instances of incorrect determinations could be pointed out but would unduly extend this review. What is figured as *Enallaster texanus* Roemer is not that species, as was clearly shown in 1922; Inflaticeras should be Perivinqueria; Ananchytes should be Echinocorys; Ostrea often should be Exogyra, etc. The lagoonal and continental Puca sandstone of Steinmann is considered to extend from northwestern Argentina entirely across Bolivia and Peru, although there is no evidence that the type area has any relationship to that of either the altiplanicie of Bolivia or that of northern Peru. The plants from Bolivia were considered Pliocene by the writer. This is not mentioned by Steinmann, who says "the plants indicate a (middle?) Tertiary (Miocene?) age."

One of the amazing correlations (p. 254) is that of the Pleistocene terraces of northwestern Peru with the glacial stages in the Alps and the marine terraces of the Mediterranean. The fact that these Peruvian terraces decline rapidly in elevation and merge south of Paita shows clearly that they are due to local changes in elevation of the land, and that they offer no physical basis for eustatic correlation. This part is profusely illustrated with text figures of fossils and synthetic geologic sections.

Part 3—"Geological History"—is really a brief summary statement of Part 2.

Part 4 on the "Structure of the Andes" is also very brief. In general it is the orthodox interpretation of the folding of the Andean geosyncline between a Pacific Coastal massif and the Brazilian shield. The Pacific massif is supposed to have sunk during the early Eocene. This early date is rendered doubtful by the absence of marine Tertiary in southern Coastal Peru, by the intense faulting of the marine Tertiary of northwestern Peru and by the lack of evidence of an ocean current corresponding to the modern Peruvian or Humboldt current even as late as the Miocene and the lack of community of faunas between the Zorritos fauna of northwestern Peru and the so-called Navidad fauna of Chile.

The Andes are regarded as essentially faulted mountains differing from the Alps in the absence of horizontal fault planes and overthrust sheets, in their less intensive folding and in their enormous amounts of plutonic and volcanic rocks. They are divided into three zones: an eastern or outer zone of intense faulting bordering the Brazilian shield and without overturned folds, thrust faulting, or magmas (amagmatische); a central zone of maximum faulting with overturned folds, imbricated thrust faulting and partly or wholly contemporaneous intrusions (Eu- and Hemimagmatische), and a western or inner fault zone of weak folding.

Part 5 is a useful enumeration and brief description of the principal mineral deposits, almost wholly descriptive rather than genetic in character; and Part 6 is a seemingly exhaustive discussion of earthquakes in Peru. The work closes with an excellent bibliography.

There can be no doubt of the usefulness of Steinmann's work, nor the value of his having brought together in one book all his information.

A feature that detracts somewhat from the permanency of the results presented is that tendency which finds its fullest expression in the Teutonic temperament of reaching conclusions on insufficient evidence and maintaining a dogmatic attitude thereafter; particularly is this evident in the ease and apparent precision of the correlations with the standard European section. Any one intimate with the situation knows that even in such a relatively limited stretch of time as the Upper Cretaceous and in as limited an area as Germany geologists have not reached anything like an agreement on correlation, and if there are uncertainties between such almost contiguous areas as Aachen and Westphalia, or Germany and France, it is surely paleontological malpractice to so definitely settle (sic) the geological history of a very imperfectly known area over twice that of Germany in another hemisphere.

EDWARD W. BERRY

JOHNS HOPKINS UNIVERSITY

# SPECIAL ARTICLES

## ON THE INCIDENCE OF INFECTION WITH INTESTINAL PROTOZOA

BECKER[1] in reporting on the result of fecal examinations of 103 patients in the New Jersey State Hospital at Trenton, using two smears from each stool, one in normal saline and the other in diluted Lugol's solution, obtained the following incidence of infection:

| | |
|---|---|
| *Endamoeba coli* | 38 |
| *Endolimax nana* | 2 |
| *Endamoeba histolytica* | 2 |
| *Iodamoeba williamsi* | 1 |
| *Girardia lamblia* | 2 |
| *Chilomastix mesnili* | 5 |
| *Trichomonas hominis* | 2 |

One additional case of *Trichomonas* was obtained by culture methods.

Having completed a similar but more extensive survey at the same institution, using smears fixed in hot Schaudinn's fluid and stained in hematoxylin, with an average of approximately six smears per patient, it is interesting to compare the results obtained by the two methods. The first 103 patients so examined gave the following incidence:

| | |
|---|---|
| *Endamoeba coli* | 6 |
| *Councilmania lafleuri* | 15 |
| *Endolimax nana* | 4 |
| *Endamoeba histolytica* | 4 |
| *Iodamoeba williamsi* | 2 |
| *Girardia lamblia* | 6 |
| *Chilomastix mesnili* | 6 |
| *Trichomonas hominis* | 2 |

By including those identified as *Councilmania lafleuri* with those recognized as *Endamoeba coli* the correspondence of results is good. It is evident that in the hands of a careful investigator the diagnosis from fresh smears is not greatly inferior to that obtained by the slower hematoxylin method.

The entire investigation of 681 patients gave an incidence of:

| | Per cent. |
|---|---|
| *Endamoeba coli* | 5.4 |
| *Councilmania lafleuri* | 10.7 |
| *Endolimax nana* | 3.7 |
| *Endamoeba histolytica* | 3.5 |
| *Iodamoeba williamsi* | 1.1 |
| *Girardia lamblia* | 3.5 |
| *Chilomastix mesnili* | 3.7 |
| *Trichomonas hominis* | 0.8 |

DAVID CAUSEY
UNIVERSITY OF ARKANSAS

[1] E. R. Becker, "Detection of Intestinal Protozoan Infections by the Cultivation Method," *Journ. Parasitol.*, 12: 4: 219–220.

## CHEMICAL TREATMENT TO SHORTEN THE REST PERIOD OF SUGAR MAPLE TREES

IN September, 1928, a little-known fungus disease of the leaves of *Acer saccharum* was found in southern Connecticut by F. A. Bartlett and the senior author. A study of the micro-organism and its effects on the host plant was planned during the winter and spring. In early October about one hundred small trees, ten to twenty-four inches high, from the infested area were potted. Some of these were placed in a greenhouse, while others were kept outside. Transferring the potted trees from outside to the greenhouse did not bring about the desired production of new leaves.

Denny and Stanton's[1] ethylene chlorohydrin vapor treatment was then tried. In a tightly sealed ash can the maple trees were exposed to a concentration of ethylene chlorohydrin of 10 ml to each 121.5 l of air space. The first treatments, during December, were for a period of twenty-four hours, but of forty-five trees so treated only one leaved and that two months after the treatment. By lengthening the period of exposure to two, three, five and twelve days it was found that during January the five-day treatment at a concentration of 20 ml of the chemical to 121–5 l of air space was the best. Out of forty-seven trees exposed for five days to the vapors of ethylene chlorohydrin, twenty-six trees, or 55 per cent., had produced leaves by February 28. The twelve-day treatment at the increased concentration caused 43 per cent. of the trees so treated to leaf out. The one-, two- and three-day treatments at the rate of 10 ml chemical to 121.5 l of air space yielded 2, 3 and 20 per cent. positive results, respectively. In no case did untreated control trees produce leaves by March 15. Trees kept outside were forced more readily than those kept inside.

By March 15, between forty and fifty trees had leaves, many of them approaching mature size. The ethylene chlorohydrin method of forcing woody plants has made possible the complete study of the fungus and its effects on the host leaves this winter.

C. G. DEUBER
P. R. BOWEN
YALE UNIVERSITY

[1] F. E. Denny and E. N. Stanton, "Chemical Treatments for Shortening the Rest Period of Pot-grown Woody Plants," *Amer. Jour. Bot.*, 15: 327–336. 1928.